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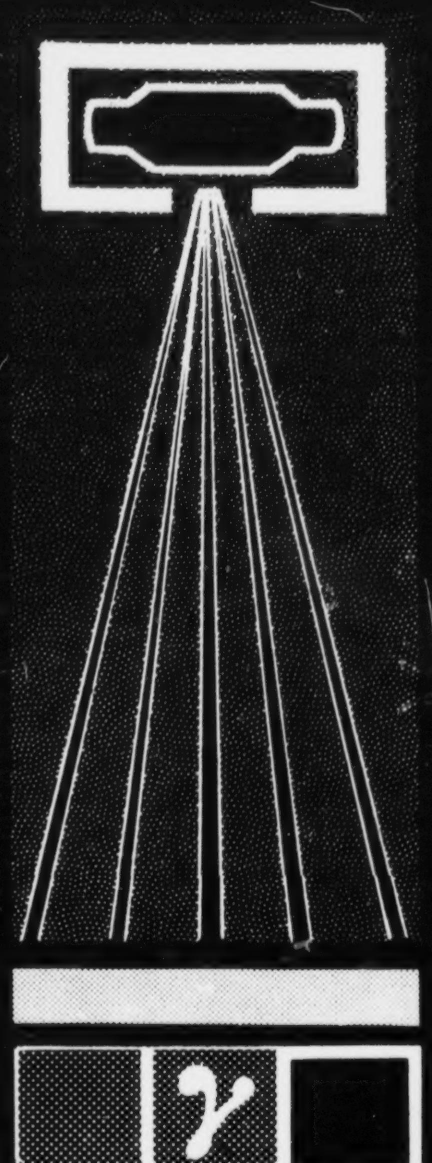

PHYSICAL SURVEY MANUAL DENTAL X-RAY

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

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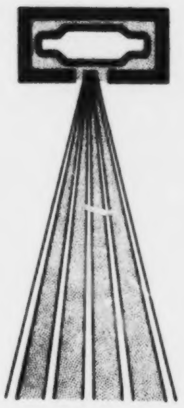
PHYSICAL
SURVEY MANUAL
DENTAL X-RAY

prepared under the direction of
Ray W. Alcox, D.D.S.

X-RAY SECTION
MEDICAL and OCCUPATIONAL RADIATION PROGRAM



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FOREWORD

The National Center for Radiological Health has primary responsibility within the Public Health Service for programs concerned with protecting the public against undue exposure to ionizing radiation, and with obtaining the maximum benefit from beneficial usage of radiation producing machines and materials. To accomplish these ends the Center maintains nationwide surveillance to determine levels of human radiation exposure from all sources; conducts research on the effects of radiation on man, and means for reducing both exposures and adverse effects; and works with official agencies and other organizations to make the most effective use of radiation—particularly in medicine and dentistry.

The use of X-rays is recognized as being an essential part of modern dental health practice, and the importance of the diagnostic use of X-rays to the provision of quality dental care cannot be overestimated. In light of our present knowledge of the potentially harmful effects from the use of X-radiation, it is necessary to balance the benefits from the use of diagnostic radiography against the risk from exposure to radiation. The increasing numbers and kinds of radiation sources make it imperative that the public's exposure to radiation be kept to a minimum consistent with diagnostic necessity.

This manual has been prepared by the X-ray Section staff of the National Center for Radiological Health, under the direction of Dr. Ray W. Alcox.

James G Terrill

James G. Terrill, Jr.
Director
National Center for Radiological Health

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We also wish to acknowledge the cooperation and assistance we have received from the manufacturers and suppliers of dental X-ray equipment, film badge services, dental X-ray film, lead aprons, protective barriers, and protective barrier materials, in the assembly of material for this manual.

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Ray W. Alcox D.D.S.

Ray W. Alcox, D.D.S.
X-ray Section
Medical and Occupational
Radiation Program
National Center for Radiological Health

INTRODUCTION

This manual has been prepared to assist State and local health agencies in development of their dental radiological health program activities by setting forth a standard physical radiation protection survey method. The manual consists of two parts: (1) an illustrated step-by-step description of an office inspection visit based upon the use of PHS Form 3657, and (2) an appendix of reference materials related to dental radiological health. The appendix is intended as a handy reference for the surveyor and other persons with an interest in dental radiological health.

The goal of good dental radiological health is to ensure the efficient use of X-ray, i.e. to obtain a maximum of diagnostic information with a minimum of radiation exposure. The judicious expenditure of radiation makes it possible to obtain more and better diagnostic radiographs with less exposure to patients. By adhering to the recommendations of the American Academy of Oral Roentgenology or the National Committee on Radiation Protection, it is possible to reduce unnecessary radiation exposure to a minimum and still obtain satisfactory diagnostic dental films. In fact, if the dental X-ray machine is properly corrected, and recommended exposure and development techniques are followed, the result will be dental films of better diagnostic quality.

Maintenance of a good relationship with private practitioners is essential if the health department is to perform its mission effectively. It is expected that the survey teams will maintain a friendly but professional and business-like attitude at all times while surveying a dental office. The surveyors are present as guests in the dental office and represent the State or local health department. This is an excellent opportunity for the survey team to impress upon the doctor that he is receiving a *service* from his health agency.

This manual assumes that two persons comprise a survey team. This has proved to be the optimum number and minimizes the inconvenience to the dental practitioner. The time involved for each office surveyed varies with different teams and the experience of the surveyors, but usually approximates 20 minutes. The use of two-man teams makes it possible to share the physical chores of carrying heavy survey equipment and to vary the duties of each survey team member so as to relieve the monotony of doing a repetitious job.

This does not mean to imply that these procedures cannot be carried out by only one person, or by three or more persons, but such arrangements have proved to be inefficient. An exception is the inclusion of the third or fourth person for training purposes when new survey teams are being formed.

THE SURVEY FORM

The present design of the Physical Survey Form (PHS-3657, Rev. 5-61) is a result of a series of evolutionary changes brought about through a number of studies. As knowledge of radiological health advanced, the form was modified and refined to its present state. When first using the Physical Survey Form, the new surveyor may feel the items are not arranged conveniently and should be rearranged so that interview questions would be in one section and actual measurement data in another section. His first impression is one of needless turning of pages, but with experience this ceases to be a problem.

The basic format was designed to satisfy the varied needs of many different State and local health agencies, since they do not seek to accomplish the same purpose or obtain the same information when conducting a physical survey. One health department may be primarily concerned with registration of dental X-ray equipment, another may wish to do a complete survey and conduct a corrective and educational program simultaneously. Consequently, the form is arranged for use in many situations.

The first half of page one is designed to secure the necessary information for registration purposes. The bottom half can be used to secure basic information about beam diameter, filtration and Roentgen output. Page two proceeds into more detailed information about equipment and starts into the area of technique. Page three is designed for use in educational efforts and provides a visible demonstration of scatter radiation to personnel operating dental X-ray equipment. Page four was designed for determination of inherent filtration of X-ray equipment by cap/on-cap/off technique. There is presently sufficient information about the inherent filtration of dental X-ray units so that visual inspection is adequate. For this reason, page four is not in general use at present, although some health departments may still use it for training or other purposes.

In order to utilize the advantages of modern data processing equipment, the form is designed for use with IBM cards, permitting the rapid tabulation of findings. This makes possible the accumulation and cross-correlation of statistical information on a State and/or nationwide basis. The time-lag between the actual physical survey and reporting of the findings is reduced because large masses of information can be handled rapidly.

The IBM card is limited to 80 items of information on each card, so the form requires one card for each page. Certain standard codes exist, and these are used when possible, particularly in the identification portion of each card. These codes are taken from published IBM Standard Codes--IBM Standard State Code, IBM Standard County Code and IBM Standard City Code. The State or local health department will assign each surveyor a code number which will be entered as item 18.

For further standardized coding within the radiological health field, it has been agreed to use the following codings, when applicable.

A - Not stated

B - Unknown

C - Not applicable

O - No or None

It is important to leave no blank spaces. *All spaces must be filled in.* The "key punch operators", who transfer the information from the Physical Survey Form to the IBM cards, know nothing about dentistry or the physical survey of dental x-ray equipment, therefore, cannot be expected to fill in blanks with proper coding. *Remember, uniform and complete coding is a must.* These "key punch operators" work on many different tabulations and are trained to punch what is recorded. If they encounter blank spaces, it can cause errors which may invalidate important information.

Some of the more commonly made mistakes and portions of the form which cause difficulty are:

1. *Failure to fill in all the blank spaces.* It is permissible, when a series of boxes are all to be scored with zeros, to mark the first box with a zero and draw a line through the rest, indicating they are also zeros.

2. *Failure to record time survey began and time survey ended.* If an office has more than one X-ray machine, the time recorded for each survey should be entered separately.

3. *Calculated average exposure time per film.* This is calculated only if the dentist uses different exposure times for different areas of the mouth. If he uses the same exposure time, item 26C is the same as item 26B.

SURVEY PROCEDURE
(Step-by-Step)

Advance arrangements to survey the dental office should be made by the State or local health department or the survey team before the actual visit.

If the dentist or dental assistant is available, have that person operate the unit during the survey procedures. If this is not feasible, it is strongly recommended that *verbal consent* to operate the equipment be obtained.

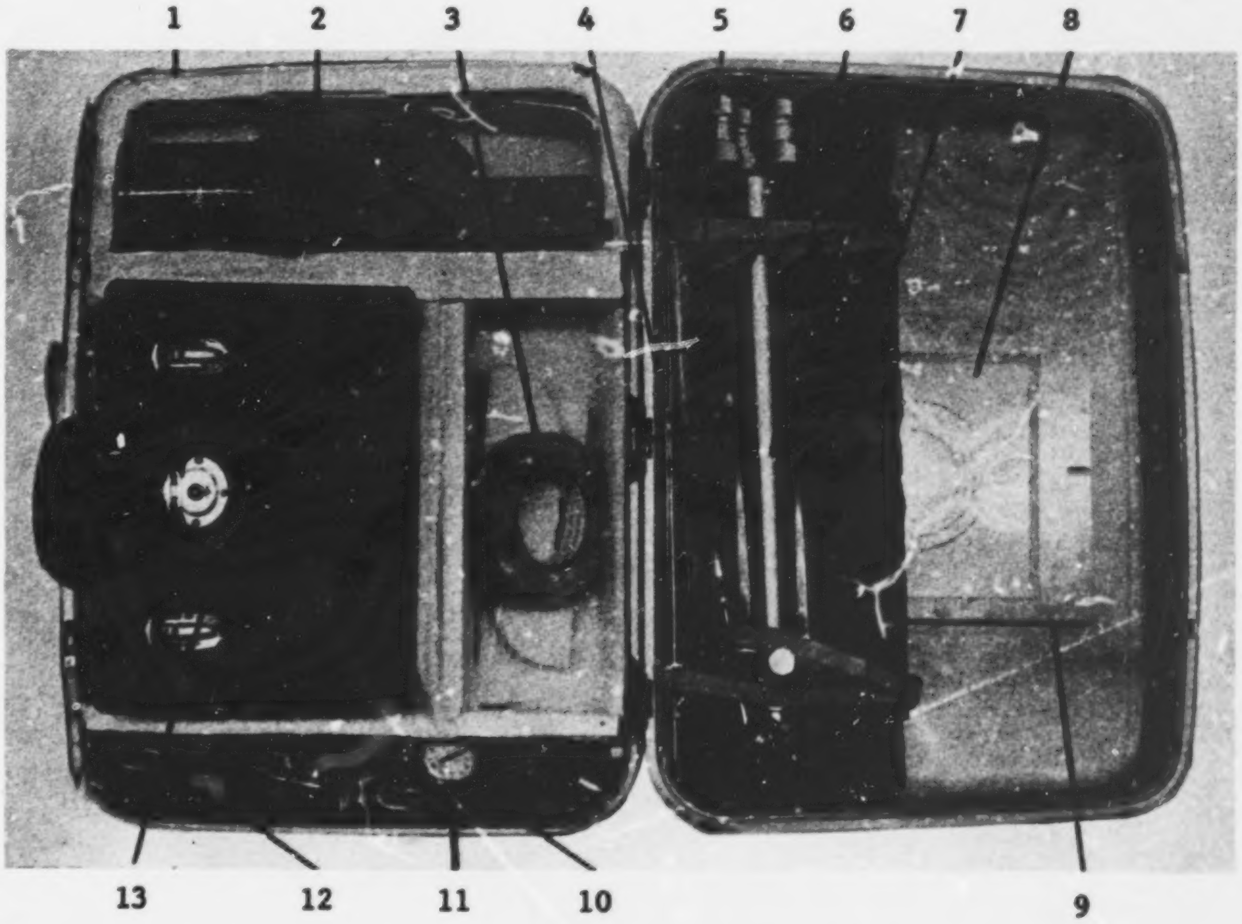
The actual survey in a dental office is best accomplished if the survey team divides the work. One team member should take the clipboard and blank survey form and secure the interview material from the dentist or the dental assistant. The other team member does the actual survey of the dental X-ray equipment and reports the findings verbally to the recorder.

THE SURVEY KIT

The survey kit contains the following equipment items, arranged as shown in the picture.

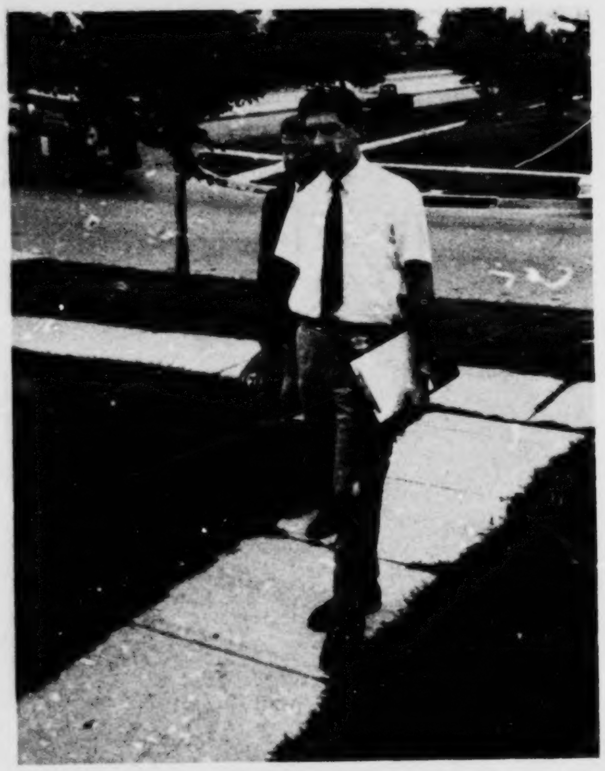
1) Samsonite case
2) ionization rate meter - "Cutie-Pie"
3) 1 roll masking tape
4) support bars
5) medical fluorescent strips
6) elevator type tripod
7) leaded protective apron
8) dental fluorescent screen with lead backing
9) tripod table top
10) ionization chamber holder
11) stop watch
12) tools (thumb screw, penlight, binder clips, 6' tape measure, round and needle nose pliers, 3 bit screwdriver set, knife, dental shears, wrenches)
13) Victoreen Condenser R-Meter:
    1-filter thickness key,
    2- 25R ionization chambers,
    1- 10R ionization chamber,
    1-0.25R ionization chamber,
    1-15.6mm. x 3" Al chamber cap,
    1-lead plate

Not illustrated is a plastic jug, which when filled with water, has proved to be a convenient and effective phantom head.



INITIAL PROCEDURE

It is usually advisable to record the name and address of the dentist whose office is to be surveyed before calling on him.



The survey team is neatly dressed and has a business-like attitude.

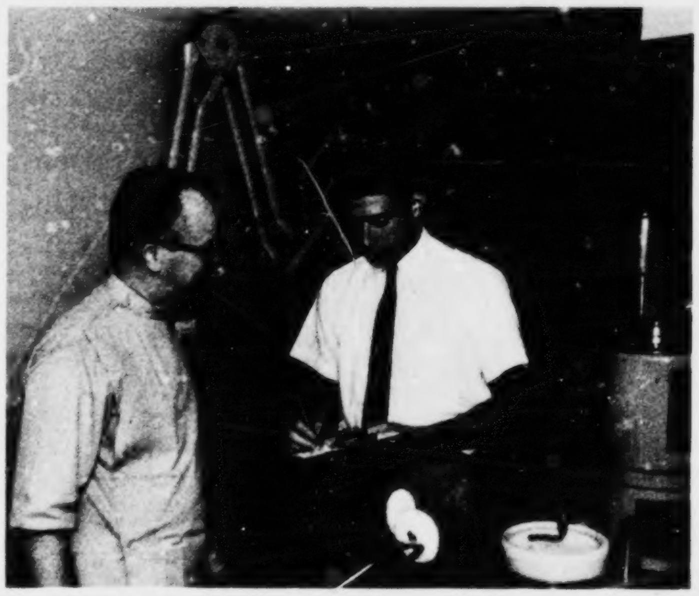
The members of the survey team introduce themselves to the doctor and/or his assistant and explain that they are representatives of the health department and have arrived to survey the doctor's X-ray equipment.

If the doctor is busy it may be necessary to wait until the dental operating room is available. If the dental assistant is not needed to assist the dentist, the recorder asks if she can supply some of the information needed.

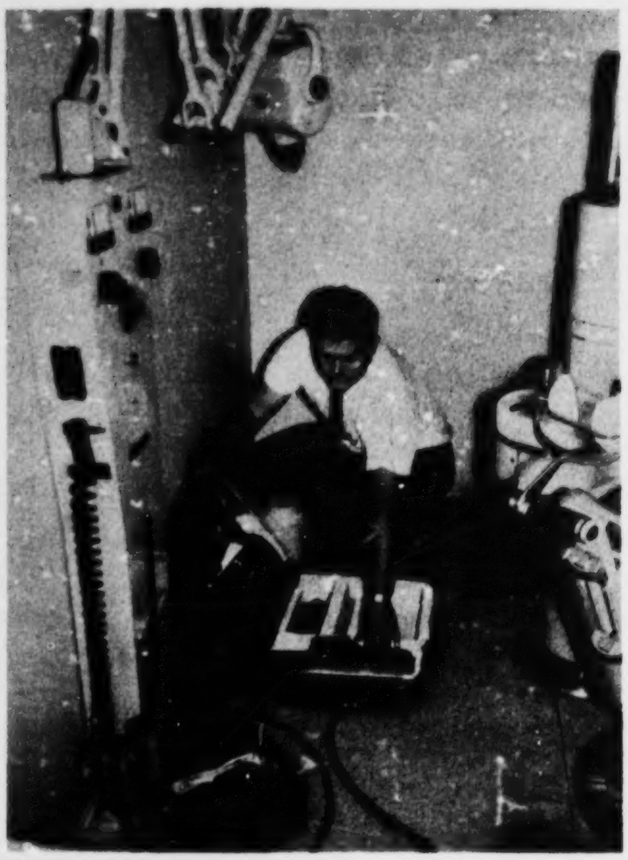
In this way it may be possible to secure the information and not take any more of the doctor's time than is necessary.

When the doctor is available, the members of the team have the assistant introduce them or they introduce themselves.

The physical surveyor requests permission to operate the X-ray machine. *It is important to get the dentist's permission to operate his X-ray machine in case something should go wrong while surveying it.* If the dental X-ray tube were to burn out during the survey procedures, it is possible the surveyor could be held personally liable if he did not have prior permission.



The recorder interviews the doctor to secure the remaining information needed.

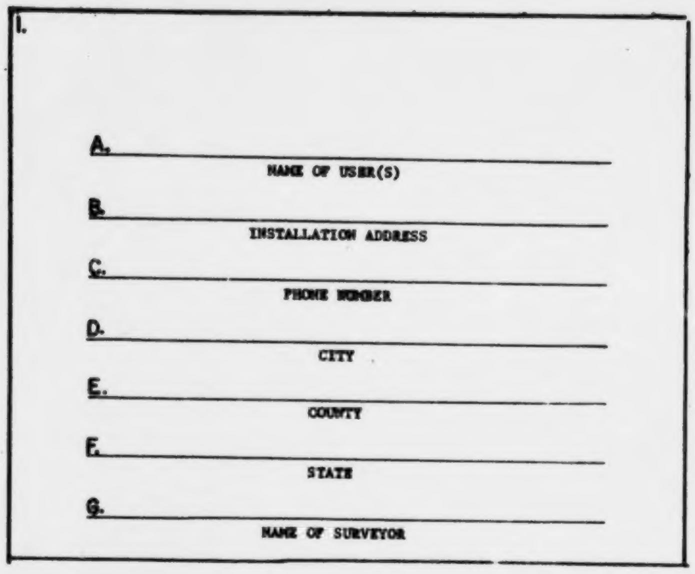


As soon as permission is received, the surveyor begins to set up his equipment.

The surveyor proceeds with the physical inspection. For his own protection, and also to demonstrate his respect for X-rays to the dentist, the surveyor always makes certain that he wears the lead apron and film badge during the actual survey procedures. (Handbook 76, U.S. Department of Commerce, National of Standards, Page 10, Section 5.6.D, has guidelines to follow in regard to placement of film badge.)

INTERVIEW PROCEDURE

The recorder proceeds to obtain the necessary items of information while the other member of the team carries out the physical survey procedures. Before the survey appointment, he should have completed items 1, 2, 3, and 18. Note the time survey begins and enter in item 15.



1.

A. ______________________
NAME OF USER(S)

B. ______________________
INSTALLATION ADDRESS

C. ______________________
PHONE NUMBER

D. ______________________
CITY

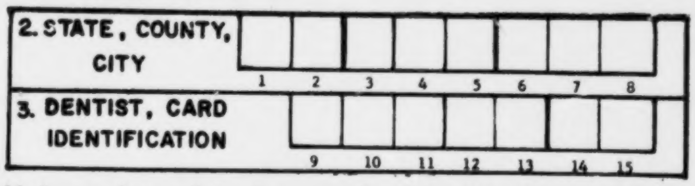
E. ______________________
COUNTY

F. ______________________
STATE

G. ______________________
NAME OF SURVEYOR

Item 1 supplies registration and identification information and all the information necessary to complete items 2 and 3.

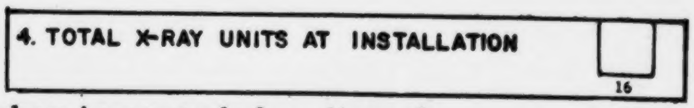
Item 2 is coded for use with IBM processing, using the IBM Standard State, County, and City Codes. Enter the appropriate State code in boxes 1 and 2; county code in boxes 3, 4, and 5; and the city code in boxes 6, 7, and 8.



2. STATE, COUNTY, CITY	1	2	3	4	5	6	7	8
3. DENTIST, CARD IDENTIFICATION	9	10	11	12	13	14	15	

Item 3 is for dentist identification and the IBM card identification. If the State or local health department assigns a code number for each dentist, it is entered in boxes 9, 10, 11, 12, and 13. Boxes 14 and 15 are used to identify which IBM card this page represents. If all three pages of the survey form are to be used, this page will be recorded as [1|3] (14, 15) - page 1 of 3 pages. The second page will appear as [2|3] (14, 15) - page 2 of 3 pages, etc. *The first 13 boxes on each page will be identical.*

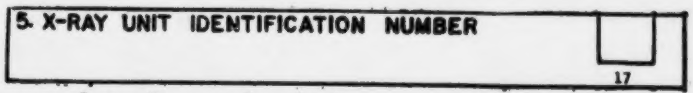
Total X-ray Units



4. TOTAL X-RAY UNITS AT INSTALLATION ☐ 16

Item 4 indicates the total number of dental X-ray units in the office. The number is recorded as item 4.

X-ray Unit Identification Number



5. X-RAY UNIT IDENTIFICATION NUMBER ☐ 17

If there is more than one dental X-ray unit in the office, the recorder assigns a number to each of them so that at this installation they can be referred to as X-ray Units #1, #2, #3, etc. *Each X-ray unit requires a separate Physical Survey Form.* Enter the number of each X-ray unit being surveyed, on separate forms, as item 5.

Number of Persons Operating This Unit

6. NUMBER OF PERSONS OPERATING THIS UNIT	☐ 18

Any person who normally takes X-rays, or assists when X-rays are being taken, is included in this total. For instance, if a dental assistant operates the timer for the doctor while he is using the X-ray equipment, she is included in the total number of persons operating the equipment. On the other hand, if the receptionist, for example, *never* helps when X-rays are being taken, she is not to be included. Enter total as item 6.

Number of Office Personnel

This item includes all those who work in the office and are connected with the practice of dentistry, such as hygienists, assistants, bookkeepers, receptionists, laboratory technicians, etc. Enter as item 7.

7. NUMBER OF OFFICE PERSONNEL	
A. FULL TIME DENTISTS	☐ 19
B. PART TIME DENTISTS	☐ 20
C. OTHER FULL TIME PERSONNEL	☐ 21
D. OTHER PART TIME PERSONNEL	☐ 22

Type of Practice

The type of practice refers to dental specialties. A dental specialist is one who has had special training and limits his practice entirely to this area. Many dentists emphasize certain areas of dental work, such as children's dentistry or prosthetics, but also do general dentistry. They are considered general practitioners and are recorded as such. Only dentists who have limited their practice to their specialty are recorded as specialists. The various dental specialties are:

Oral surgery	- that branch of dentistry that deals with the surgical treatment of diseases and injuries of the mouth, teeth, and adjacent tissues.
Orthodontia	- that branch of dentistry which deals with the prevention and correction of irregularities of the teeth and malocclusion.
Pedodontia	- that branch of dentistry which deals with the teeth and mouth conditions of children.
Periodontia	- that branch of dentistry dealing with the study and treatment of periodontal diseases.
Prosthodontia	- that branch of dentistry which deals with the design and fabrication of dental appliances and substitutes, such as crown, bridges, artificial dentures, etc.

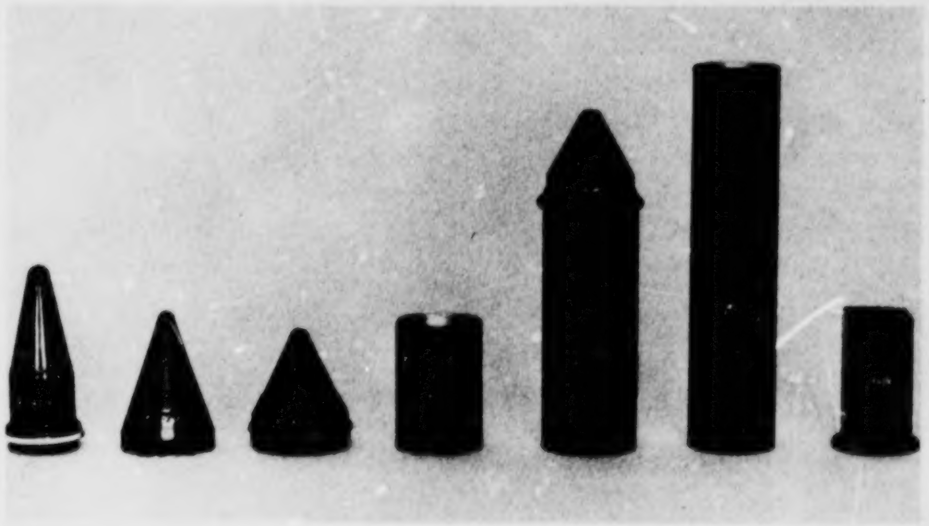
Other, the specialities of Endodontics, Oral Pathology, and dental X-ray installations located in clinics, hospitals, military installations, etc., are recorded as other. Record your findings as Item 8.

8. TYPE OF PRACTICE	1. GENERAL______ 2. ORAL SURGERY____ 3. ORTHODONTIC_____	4. PEDODONTIC______ 5. PERIODONTIC______ 6. PROSTHODONTIC_____	7. MORE THAN ONE TYPE_____ 9. OTHER (SPECIFY) ________________	☐ 23

X-ray unit identification, field diameter, filtration, Roentgen output, and other items of information secured by the physical surveyor are recorded whenever circumstances permit. It is usually possible to record these items of information as they are obtained or they can be copied later from notes made by the physical surveyor.

Pointer Cone

This item refers to the plastic aiming device attached to the tubehead. Most X-ray units have a short pointed cone. All cones which establish a target-face distance of *eight inches or less* are classed as short cones.



The above illustration shows some of the commonly encountered cones. The cone at the far left is one found on many later model General Electric X-ray units. Some surveyors tend to record this as a long pointer cone, but since this cone actually establishes an 8" target-face distance, it is classed as a short cone. Record cone type as item 10.

10. POINTER CONE

0. NONE ______
1. SHORT POINTED ______
2. SHORT OPEN ______
3. LONG POINTED ______
4. LONG OPEN ______
9. OTHER(SPECIFY) ______

☐ 43

Protective Barriers

Protective barriers can greatly reduce the occupational exposure of working personnel and the dentist or his assistant should be consulted as to their presence. If a barrier is present, inquire to what extent it is used. If the dentist uses other materials, such as the structural components of his office, as a protective barrier, enter this information as "other" with a notation on type of material so used. (Illustrations of common types of protective barriers are included in the appendix.) Enter this information as Item 23.

23. PROTECTIVE BARRIERS

0. NONE ______
1. FIXED WITH LEAD WINDOW ______
2. FIXED WITH NO LEAD WINDOW ______
3. MOBILE WITH LEAD WINDOW ______
4. MOBILE WITH NO LEAD WINDOW ______
5. PRESENT BUT NOT IN USE ______
9. OTHER (SPECIFY) ______

☐ 24

Lead Aprons

Protective leaded aprons are generally recommended for patients, expecially children and young women in the reproductive ages. Certain States have laws requiring a dentist to use such a protective device on their patients, while others only recommend it. Your position on this subject is determined by your State or local health department's policy. An apron of .25 mm. lead equivalent is adequate for patient protection for nearly all dental X-ray procedures. Such protective aprons are usually rubber or plastic materials impregnated with finely powdered lead. The shape varies widely, ranging from an apron which completely covers the patient's torso to a 12" square lap apron laid over the gonadal area.

Protective apron requirements for operating personnel are determined by workload and the physical layout of the office. In some situations it may not be possible for operating personnel to utilize available shielding or to move far enough away from the tubehead for adequate protection. In such an instance, the use of a protective apron by the operator is indicated.

Record your findings as item 24. (Illustrations of some of the lead aprons available are included in the appendix.)

24 LEAD APRONS
0 NONE ______
1. OPERATOR ONLY ______
2. PATIENT ONLY ______
3. BOTH OPERATOR AND PATIENT ______
4. PRESENT BUT NOT IN USE ______
☐ 25

Personnel Monitoring

Personnel monitoring concerns the use of radiation monitoring devices by the dentist and/or his personnel to determine if they are receiving excessive radiation exposure. The form of such monitoring devices varies widely. In the order that they appear in the survey form, they are briefly described as follows:

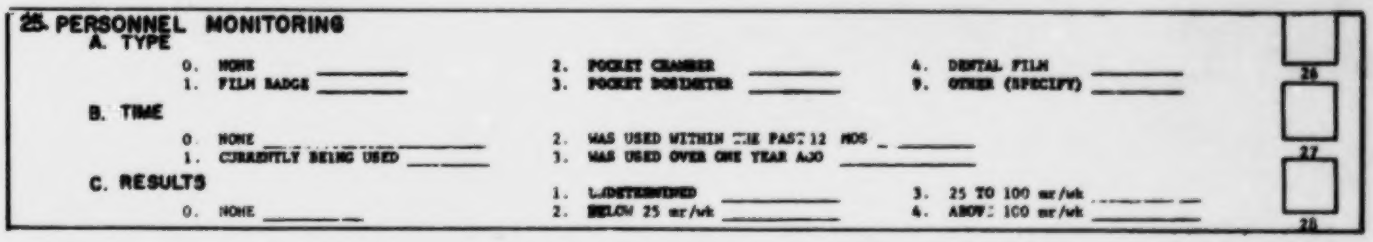
Film Badge. This consists of a holder into which a special film packet is inserted. Generally, the holder has a clip which enables the user to fasten it to his clothing while he is working. Film badge service is sold on a contract basis by companies which specialize in such services. The films are supplied by the company and must be returned for processing. After processing, the company reads the film and reports the findings to the dentist by mail. This is an accurate and economical method of measuring exposure to the dental personnel and provides a permanent record of exposure.

Pocket Chamber. This is a device about the size of a fountain pen which can be carried in the user's pocket. A separate charger-reader is required in order to use this device which can be read by the practitioner in his office. (This is basically the same instrument as the Victoreen R-Meter which is used to determine X-ray unit output.) Its principal advantage is its relatively low cost as compared to the dosimeter.

Pocket Dosimeter. This is a self-reading device, also about the size of a fountain pen. A separate charger is required. The principal advantage is that it can be held up to a light source and read at any time. The chief disadvantage lies in the fact it is relatively expensive.

Dental Film. Quite often a dentist will tape a penny or a paper clip on a dental film and carry it in his pocket for a time if he thinks he might be exposed to radiation. After a time he will process and examine it. If the metal object shows on the processed film, the individual has received radiation exposure, but the amount is unknown. Negative findings by such a method are generally unreliable because of variations in film speed and processing. Positive findings indicate a need for more accurate personnel monitoring methods and better radiation hygiene practices.

(Illustrations of film badges, pocket chambers, and dosimeters are included in the appendix.) Items 25B and 25C are self-explanatory. Report your findings as item 25.



25. PERSONNEL MONITORING
A. TYPE
0. NONE ______ 2. POCKET CHAMBER ______ 4. DENTAL FILM ______
1. FILM BADGE ______ 3. POCKET DOSIMETER ______ 9. OTHER (SPECIFY) ______
☐ 26
B. TIME
0. NONE ______ 2. WAS USED WITHIN THE PAST 12 MOS ______
1. CURRENTLY BEING USED ______ 3. WAS USED OVER ONE YEAR AGO ______
☐ 27
C. RESULTS
1. UNDETERMINED ______ 3. 25 TO 100 mr/wk ______
0. NONE ______ 2. BELOW 25 mr/wk ______ 4. ABOVE 100 mr/wk ______
☐ 28

The National Committee on Radiation Protection (NCRP) has recommended that the exposure of one who is occupationally exposed to X-ray radiation *should not exceed 100 mR per week.* In view of present knowledge, this amount is not expected to cause any detectable bodily injury during his lifetime. (For more detailed information on the maximum permissible doses recommended by the National Committee on Radiation Protection refer to the National Bureau of Standards Handbooks 59 and 76.)

Workload

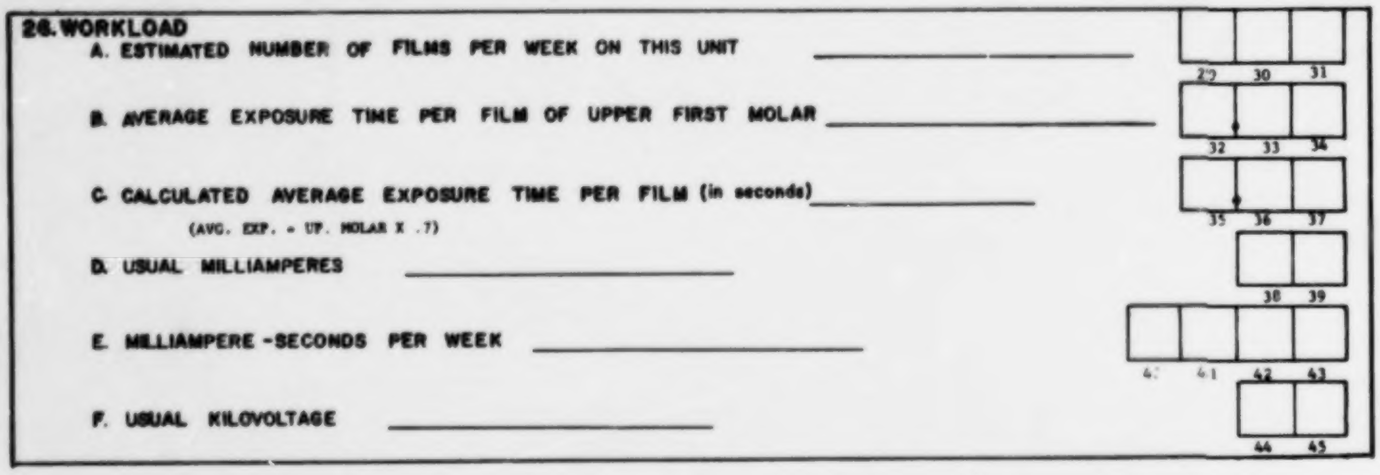
Information for items 26A and 26B is obtained by asking the dentist or his assistant. Quite often the dentist will be unable to supply accurate information in this area. The information sought is for an *average* workweek. If the dentist is uncertain as to the X-ray workload, a clue may be provided by asking how often he has to reorder X-ray film or how long a package of film lasts him. Regular periapical films are supplied in gross quantity packages (usually 150 instead of 144) and bitewing films are supplied in packages of 25. From this information it may be possible to estimate the workload. Another approach is to ask how many fullmouth surveys (usually 14 films, but may vary from 10-22), how many bitewing exposures (2 or 4 films may be used), and how many single exposures he takes in a specified time period.

Item 26C is calculated by multiplying the average exposure time for the upper first molar by .7 (7/10). *This is done only if the dentist uses a different exposure time for the different areas of the mouth.* Usual dental X-ray practice requires slightly longer exposure times in the molar area than in the anterior because of the greater mass and density of the tissues present. However, some dentists do not vary their exposure times with the area being X-rayed. If they do not vary their exposure times, enter the same information in item 26C as appears in item 26B.

The usual milliamperage and kilovoltage at which the dentist operates is recorded as items 26D and 26F, respectively. It is necessary to ask the dentist if he adjusts his machine to certain dial readings, or if he uses it as it is set. If he does not adjust the equipment, the readings are recorded as indicated from the dial settings.

If the machine does not have dials that supply this information, enter the kVp and mA figures listed in the Dental X-ray Units - General Information chart, which is included in the appendix.

Item 26E is the product of the average number of films per week (26A), times the usual milliamperage (26D), times the average calculated exposure time per film (26C). Items 26C and 26E may be calculated and recorded after leaving the office.



26. WORKLOAD

A. ESTIMATED NUMBER OF FILMS PER WEEK ON THIS UNIT ______________ 29 30 31

B. AVERAGE EXPOSURE TIME PER FILM OF UPPER FIRST MOLAR ______________ 32 33 34

C. CALCULATED AVERAGE EXPOSURE TIME PER FILM (in seconds) ______________ 35 36 37
(AVG. EXP. = UP. MOLAR X .7)

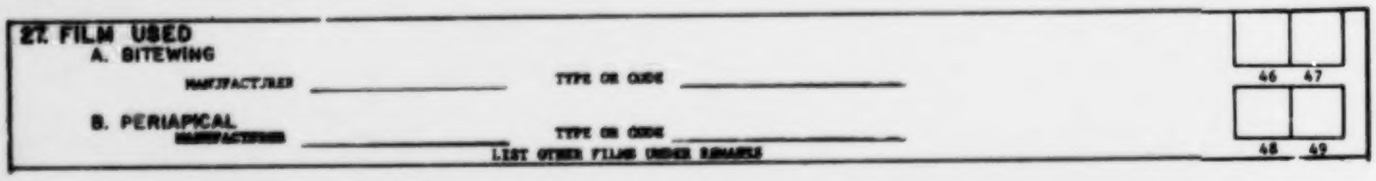
D. USUAL MILLIAMPERES ______________ 38 39

E. MILLIAMPERE-SECONDS PER WEEK ______________ 40 41 42 43

F. USUAL KILOVOLTAGE ______________ 44 45

Film Used

Determination of the brand of film used is obtained by asking the dentist or his assistant and examining a film packet, if one is available. Dentists will sometimes use the same film for periapical exposures that they use for bitewing exposures. To do this, the use of a gummed tab or a paper loop is necessary. If the dentist uses only one film for both kinds of exposures, enter the same information in both items 27A and 27B.



27. FILM USED

A. BITEWING
MANUFACTURER ______________ TYPE OR CODE ______________ 46 47

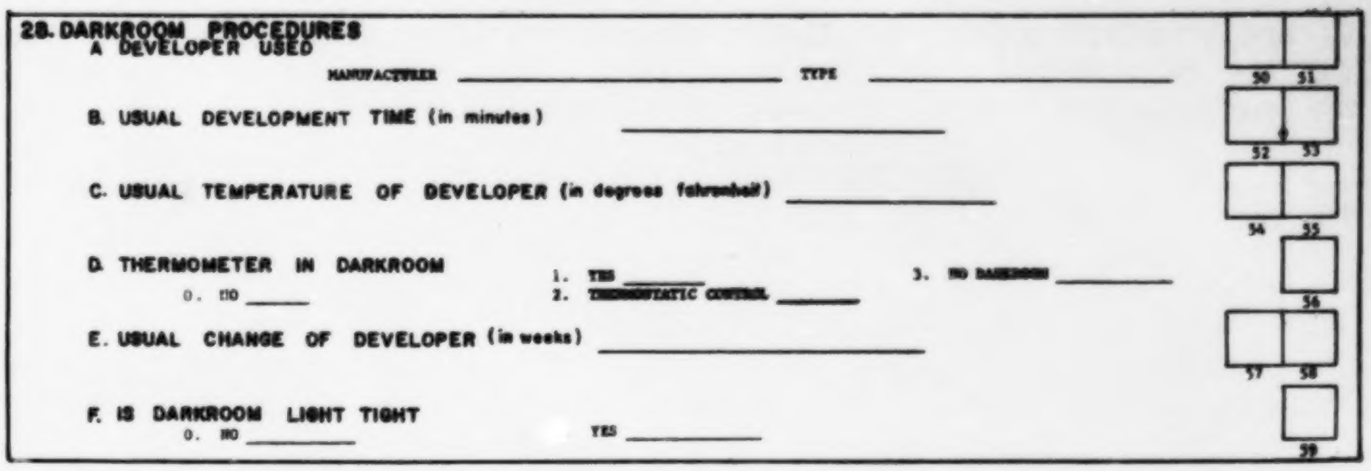
B. PERIAPICAL
MANUFACTURER ______________ TYPE OR CODE ______________ 48 49

LIST OTHER FILMS UNDER REMARKS

Generally, the type or code number of the X-ray film is found on the end of the packet. (A complete list of dental X-ray films and illustrations, showing the location of their code numbers, is included in the appendix.)

Darkroom Procedures

Item 28 requires a combination of interviewing and observation to complete. The brand of developer used is obtained from the label on the bottle, if possible, and is recorded as item 28A. Most manufacturers market only one developer for dental X-ray film; but a few, notably General Electric, market more than one type, which necessitates specifying the type in this instance.



28. DARKROOM PROCEDURES

A DEVELOPER USED

MANUFACTURER ____________ TYPE ____________

B. USUAL DEVELOPMENT TIME (in minutes) ____________

C. USUAL TEMPERATURE OF DEVELOPER (in degrees fahrenheit) ____________

D. THERMOMETER IN DARKROOM

0. NO ______ 1. YES ______ 2. THERMOSTATIC CONTROL ______ 3. NO DARKROOM ______

E. USUAL CHANGE OF DEVELOPER (in weeks) ____________

F. IS DARKROOM LIGHT TIGHT

0. NO ______ YES ______

50
51
52
53
54
55
56
57
58
59

Item 28B, Usual Development Time, is recorded as reported by the dentist, unless he states that he *"sight" develops* his films. *"Sight" developing* is a process by which the development is observed under a safelight. When the latent image appears to have reached the proper stage of development, the film is rinsed and cleared in the fixing bath. This method, although highly subjective and apt to produce inconsistent results, is quite widely used. If the dentist or his assistant *"sight" develop* their films, record it as *9.9.*

Item 28C, Usual Temperature of Developer, is recorded as the dentist reports it. Quite often the temperature of the developer will be approximately room temperature, which is usually 68° - 72°. This may be reported as the temperature used. If the dentist has *no thermometer* or does not use one, record item 28C as *99*. Frequently, if "sight" developing is reported, the dentist will not use a thermometer. If he uses a thermometer in his tanks, report his estimation of usual tank temperature as the temperature of developer.

Item 28E, Usual Change of Developer, is reported as number of weeks between changes. Often the dentist is not aware of how often he changes or cleans his developing tanks. Here again, his record of purchases may be a convenient way of establishing the time interval. If you are unable to determine the time interval, and the dentist reports that he changes when the solutions get *weak or dirty*, report it as 99. Occasionally you may find a situation in which he reports that he does not change his tanks, but adds replenisher when necessary. This is most likely to occur at a very busy installation where a large volume of radiographs are processed.

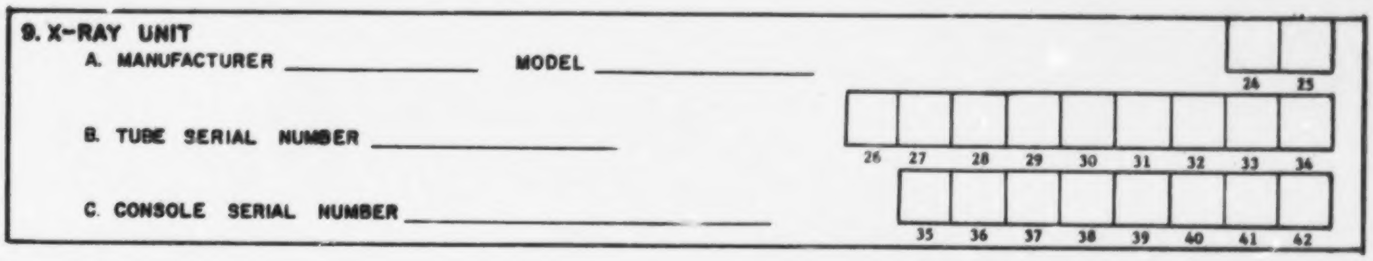
Item 28F, Is Darkroom Light Tight, is subjective and will vary widely among surveyors. To check this item, step into the darkroom and close the door tightly. It may be well to tell the dentist or his assistant beforehand what you are going to do, since the darkroom is often also used for storage. Wait a few moments for your eyes to adapt themselves and then look for *light leaks*. If you can readily detect light leaks around the door, window, or anywhere else, the room is not light tight.

Record your findings as item 28F. A surprisingly high percentage of darkrooms will not be light tight. Ultrafast dental film, which is recommended as one of the best means of reducing unnecessary radiation exposure, is also very sensitive to light, much more than the slow or intermediate speed dental X-ray film. For this reason, a good darkroom becomes very important if the dentist is to use ultrafast film successfully.

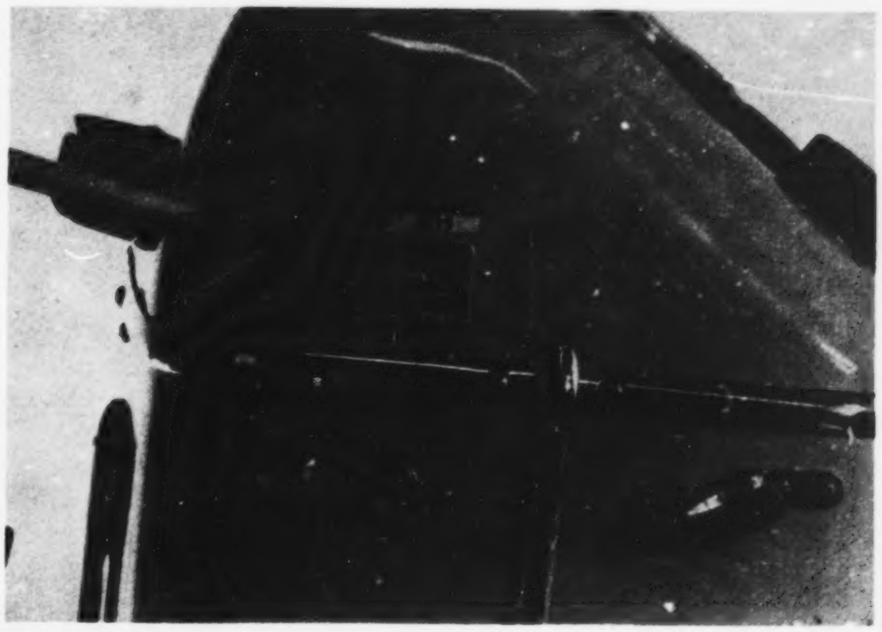
If you should observe a faulty darkroom and have an opportunity to bring it *diplomatically* to the dentist's attention, do so. You will be doing him a favor. A few words of explanation about the importance of a good darkroom and good darkroom technique in obtaining satisfactory dental radiographs may be a lot of help to a dentist who has been having difficulty.

Equipment Identification

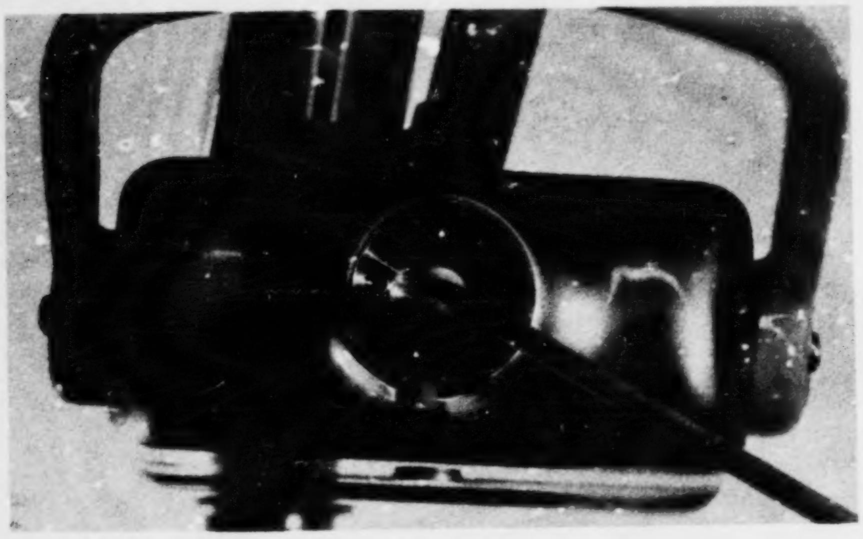
Either the interviewer or the surveyor may obtain the make, model, and serial number and record them in item 9. Generally it is easier for the surveyor to get this information and read it to the interviewer. This information is located on the machine in different places, depending upon the make and model of the equipment. (The appendix contains information about the location of serial and model numbers on different X-ray units.)



9. X-RAY UNIT
A. MANUFACTURER ______________ MODEL ______________ ☐☐ 24 25
B. TUBE SERIAL NUMBER ______________ ☐☐☐☐☐☐☐☐☐ 26 27 28 29 30 31 32 33 34
C. CONSOLE SERIAL NUMBER ______________ ☐☐☐☐☐☐☐☐ 35 36 37 38 39 40 41 42



The most common location of serial numbers is on the side or back of the console and is often difficult to read.

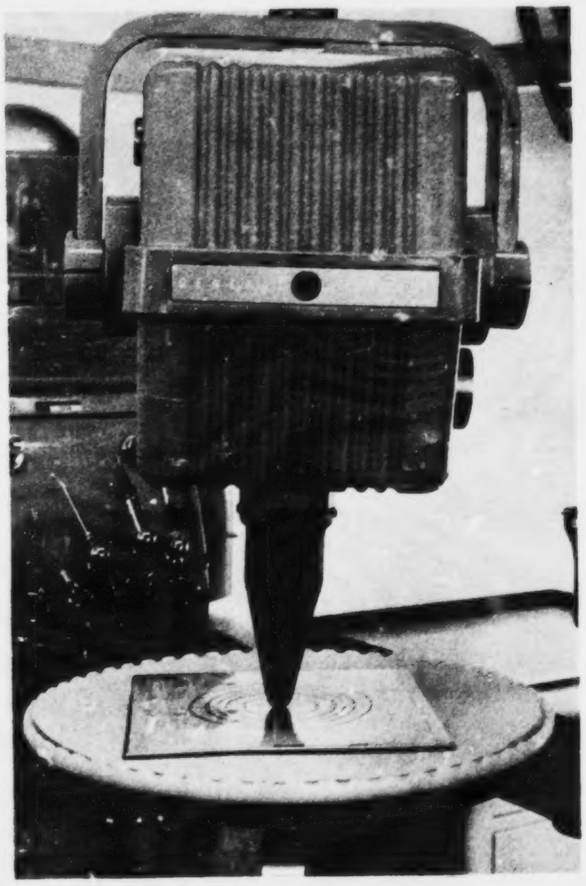


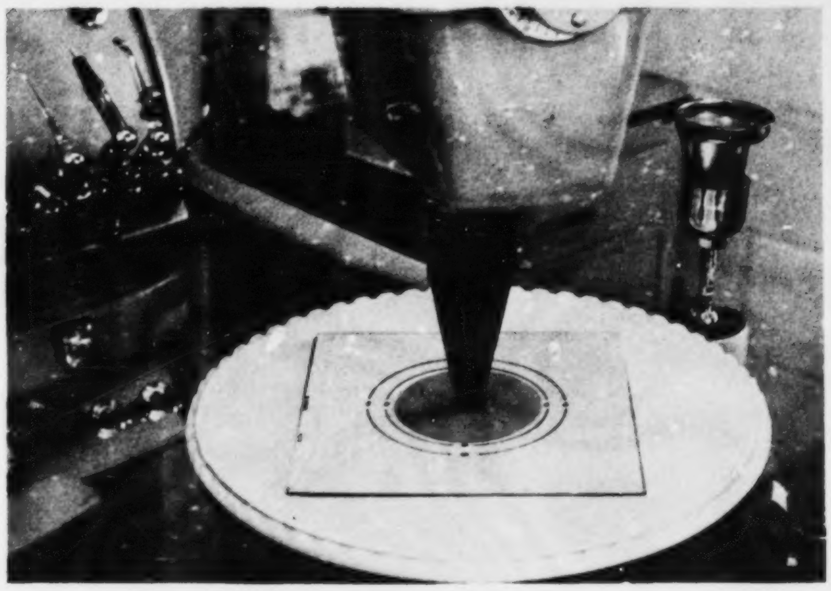
Most units have the tube serial number on the tube housing under the pointer cone. If it is under the pointer cone, removal of the cone is necessary. It may be advisable to wait and secure this information when the cone is removed to check for filtration and collimation.

Field Diameter

The surveyor prepares to determine the beam size by setting the fluorescent screen on the bracket table (only if free of dental instruments and medicants) or on the tripod table top, whichever is more convenient.

The tube head is aligned perpendicularly and centered on the fluorescent screen (note the lead backing). If possible the blinds should be closed and the operatory darkened for easier reading of the fluorescent screen.





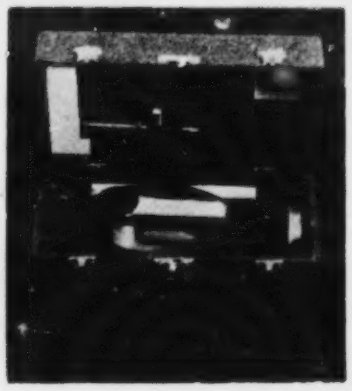
The machine is turned on and an exposure of approximately two or three seconds is made while the surveyor, standing well away, reads the diameter of the fluorescent area on the screen. (The illustration shows a beam diameter of 3-1/2".) He notes the beam diameter and reports it to the recorder or makes a separate record on scratch paper until such time as the recorder is available. This information is recorded *in decimal form* as item 11A.

11. FIELD DIAMETER AT END OF POINTER CONE (inches)

A. BEFORE MODIFICATION ______________________ ☐☐☐ 44 45 46

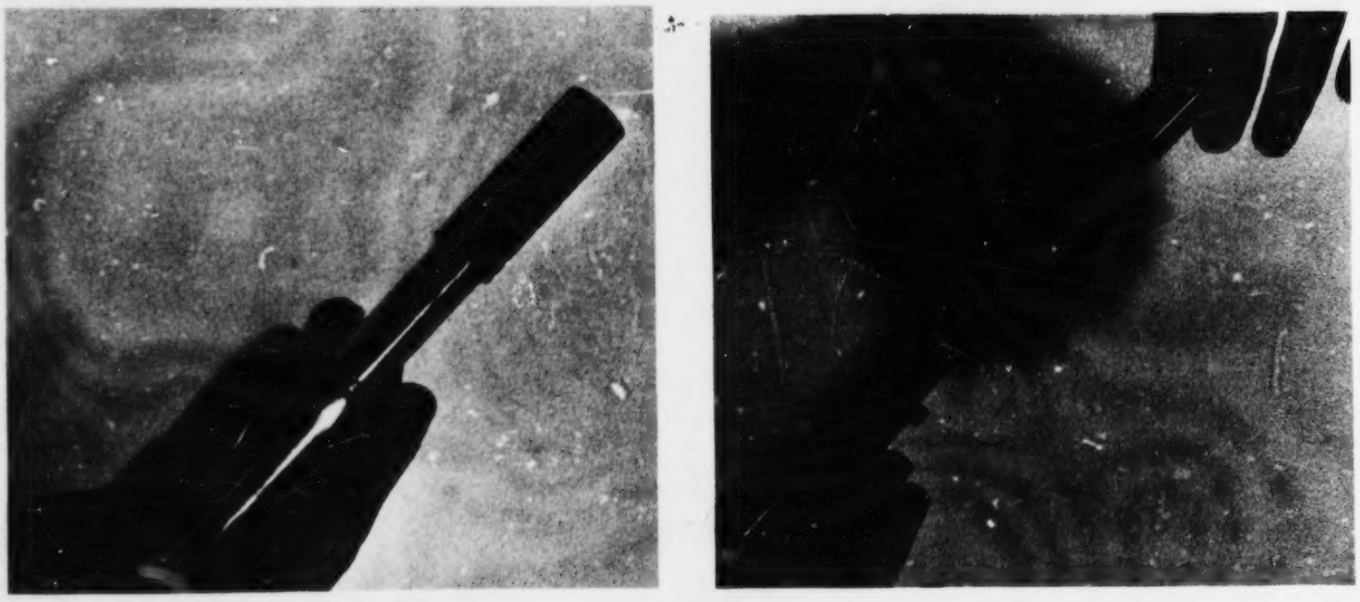
B. AFTER MODIFICATION ______________________ ☐☐☐ 47 48 49

Roentgen Output

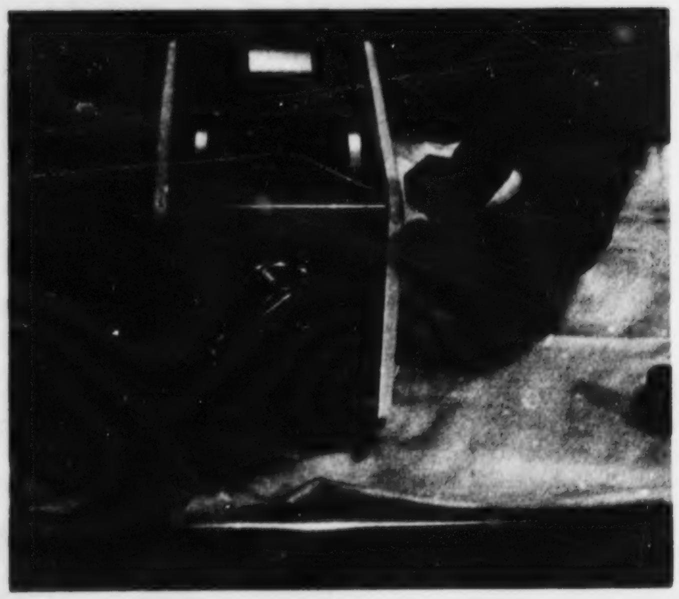


The surveyor next prepares to determine the Roentgen output of the X-ray equipment. The case containing the Victoreen Condenser R-Meter is removed from the kit and opened.

The charger-reader is removed, the cord connected to a convenient 110-115 v. electrical outlet and the plastic plug in the charger-reader opening removed. (The plug keeps dirt particles out of the charger-reader which affects the accuracy of the readings. The plug should be kept in position when the device is not in use.)

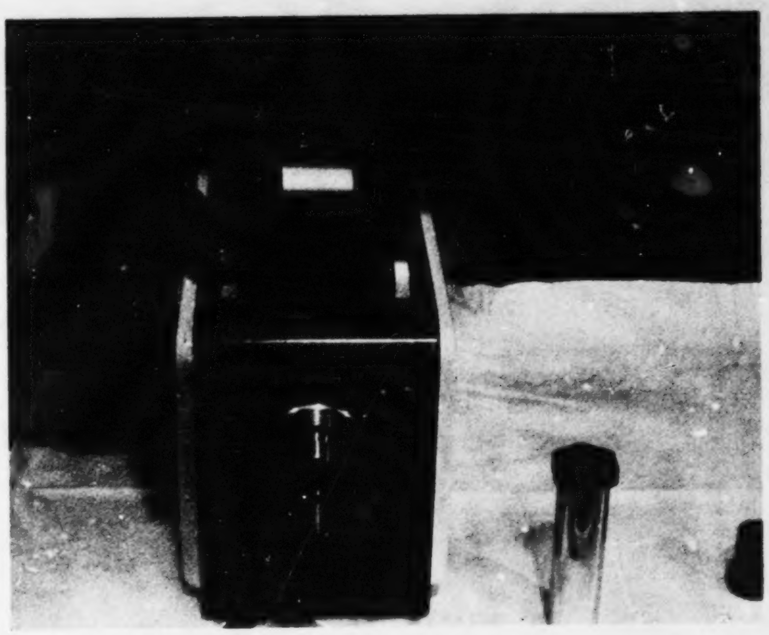


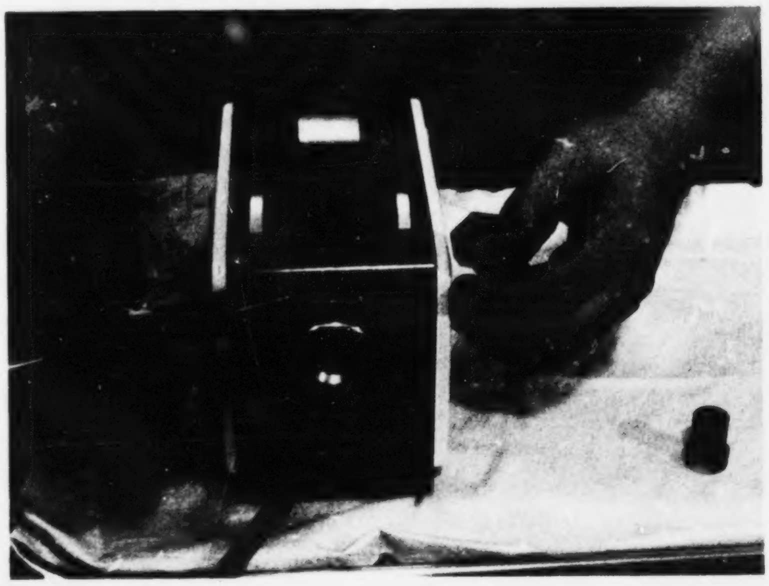
A 25 R chamber is selected and the plastic cap removed.



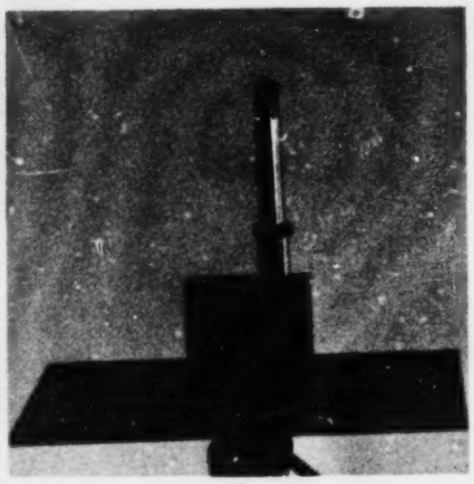
The 25 R chamber base is removed and the chamber inserted into the charger-reader. A one-quarter twist of the chamber will engage the chamber and lock it firmly in place.

The chamber is charged by moving the adjustment on the left side back to *charge* position. Check to see if the scale indicator is on zero. If not, hold the charge adjustment on *charge* and adjust the instrument to zero by manipulating the *zero set*.

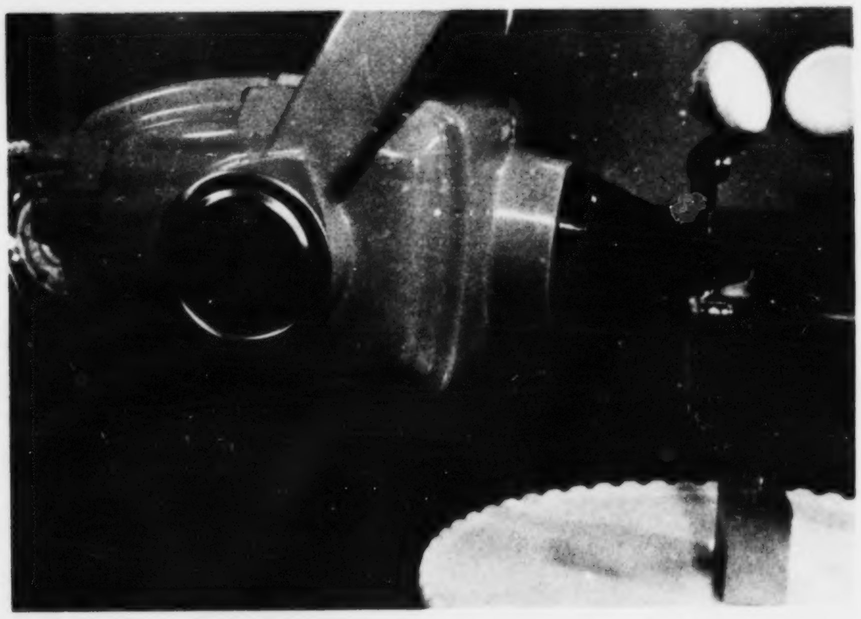


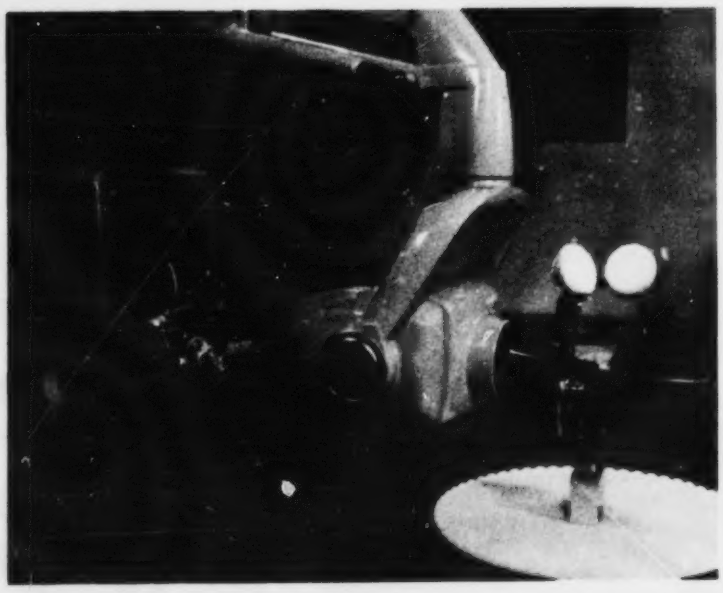


As soon as the zero is adjusted, release both *charge* and *zero set* controls. Remove the chamber and insert it into its base. *Care should be taken not to touch the end of the chamber* because this contact may discharge the chamber.



Place the ionization chamber holder on the bracket table or the tripod platform and install the chamber in one of the holes.





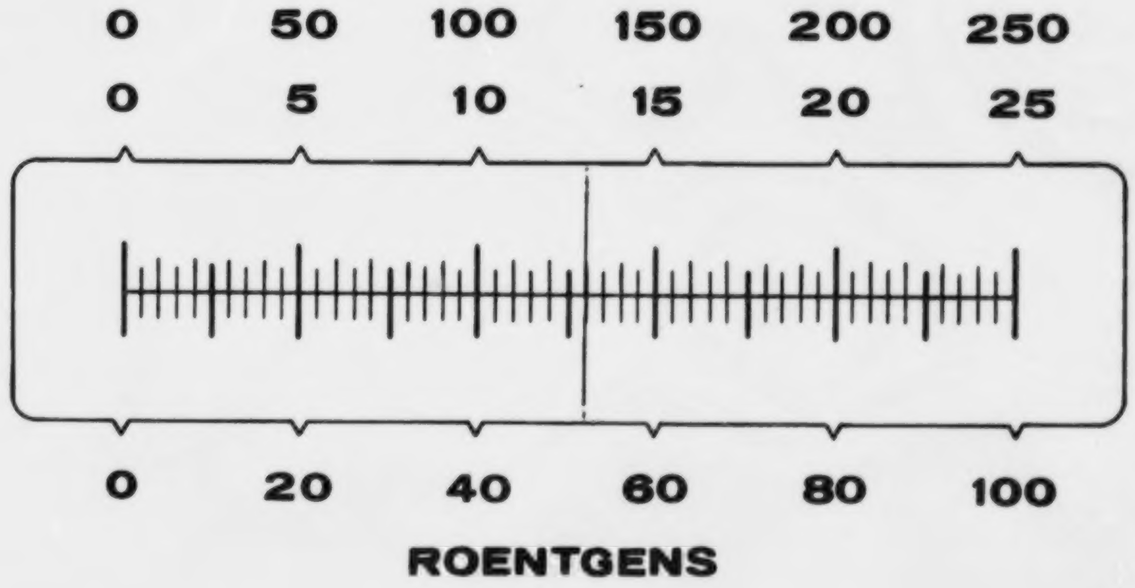
Position the tubehead so that the top of the pointer cone just touches the plastic tip of the chamber and is directed horizontally away from occupied areas. The X-ray machine is turned on and the chamber exposed.

The amount of total exposure time necessary is variable and sufficient exposure must be made so that the reading obtained is near the center of the scale of the Condenser R-Meter. This is necessary since readings are more accurate in the center area of the scale and are quite variable at either end.

Generally speaking, it is best to break up the exposure into several shorter exposures with a time interval between to protect the tube from overheating and to avoid any danger of burning out the tube. With a 65 kVp machine two three-second exposures are often satisfactory. *It is inadvisable to operate a dental X-ray machine for longer than three seconds at any one interval.* With higher kVp machines, two two-second exposures will probably suffice while low kVp machines (45-50) may require three three-second exposures. In any event, the total exposure time is determined by the total amount of radiation necessary to give mid-range readings on the charger-reader.

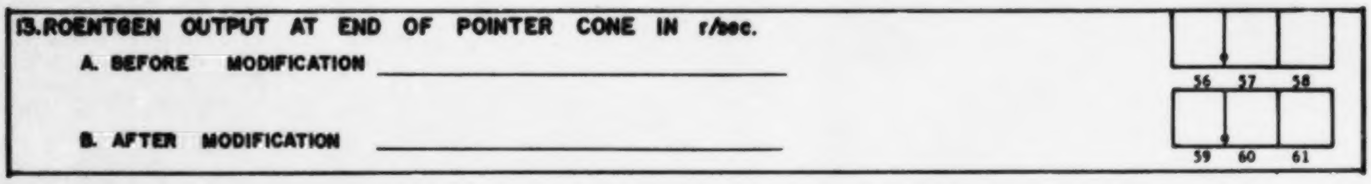
Before reading the chamber check the charger-reader to see if the scale indicator is on zero. Adjust to zero if necessary. Remove the chamber from the holder, remove the base, and re-insert the chamber into the charger-reader. Care should be taken to avoid rough handling. Take the reading, being careful to read the correct scale for the chamber used.

The scale used is determined by the capacity of the chamber, which for dental equipment is the 25 R chamber. The correct reading in the sketch below is 13, assuming it is obtained from a 25 R chamber.



(The sketch shows the scales as seen through the eyepiece of the charger-reader.)

The reading observed is the Roentgen output for a specified number of seconds. To calculate the true Roentgen output per second, divide the number observed on the scale by the total number of seconds of exposure (e.g., a reading of 13 Roentgens was obtained with two three-second exposures: 13 R/6 sec = 2.16 R/sec). This number can be calculated and recorded in the appropriate squares (item 13A) at a later time.



13.ROENTGEN OUTPUT AT END OF POINTER CONE IN r/sec.

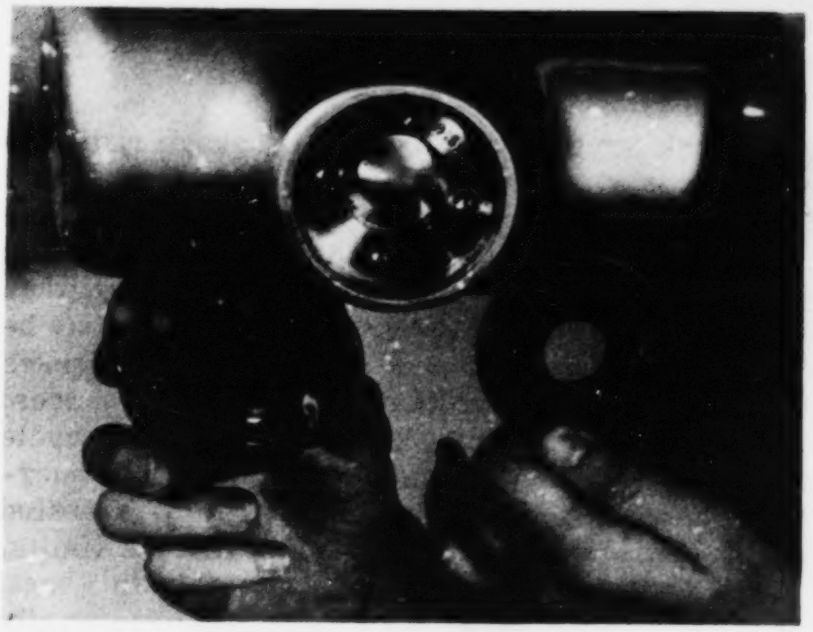
A. BEFORE MODIFICATION ______________________ 56 57 58

B. AFTER MODIFICATION ______________________ 59 60 61

Filtration

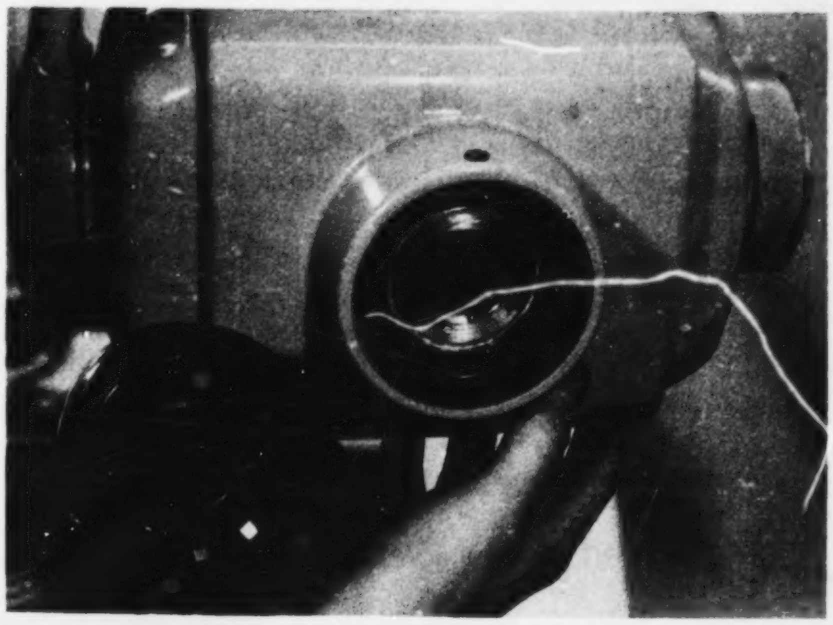
The next step is to check the X-ray unit for total filtration. Total filtration is the sum of inherent filtration and added filtration. Inherent filtration is the absorption of the X-ray beam caused by the glass wall of the tube, the oil or air surrounding the tube, and the tubehead seal. Added filtration is that filtration placed in the primary beam to absorb the low-energy or "soft" X-rays which do not contribute to the radiograph.

A difference does exist in the recommendations made by National Bureau of Standards Handbook 76 and the American Academy of Oral Roentgenology. Depending upon which recommendations the health department adopts for its standards, a late model X-ray unit could meet State or local standards without modification. The approximate inherent filtration in millimeters of aluminum equivalent for a particular make or model is obtained by referring to the Dental X-ray Units - General Information chart, which is included in the appendix. This chart also recommends the amount of additional filtration needed. The recommendations are based on a total of 2 mm. aluminum for machines operated at 70 kVp or below and 2.5 mm. aluminum for machines operated above 70 kVp. These standards may vary slightly from those adopted by your health agency but it should be borne in mind that the recommended standards are to be considered as *minimum* standards. In any event, the cone of the machine should be removed, if possible. Care should be taken not to damage the cone by dropping it or stripping the threads. With the pointer cone removed, it is generally possible to see if filters and collimators are present and to determine if factory installed filtration has been removed or modified.



Remove the pointer cone. Note the tube serial number if there is one recorded in this location.

At this time, it is possible to determine if the filtration and collimation have been modified. If there is no additional filtration, record the inherent filtration from the chart, Dental X-ray Units - General Information, in the appendix. Add any additional filtration present to the inherent filtration indicated by the chart. Enter these findings as item 12A.



12. TOTAL FILTRATION OF PRIMARY BEAM (mm Al equiv.)

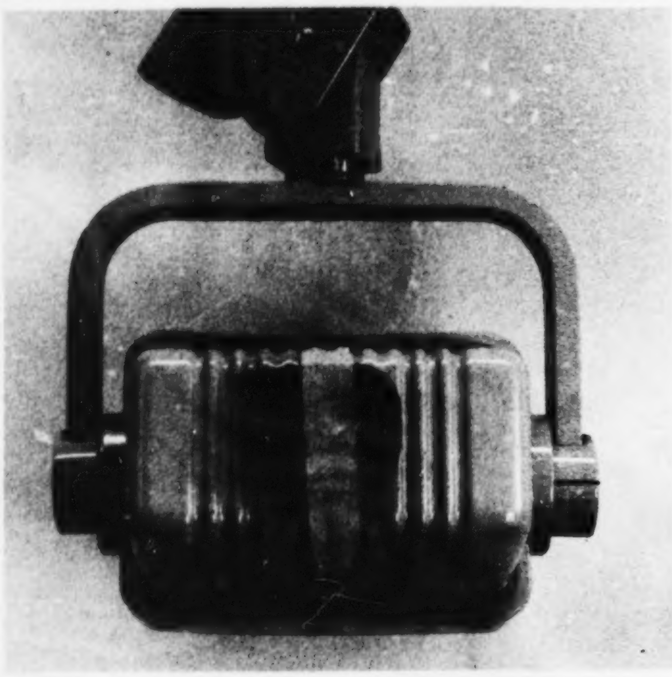
A. BEFORE MODIFICATION ______________________ ☐ ☐ ☐ 50 51 52

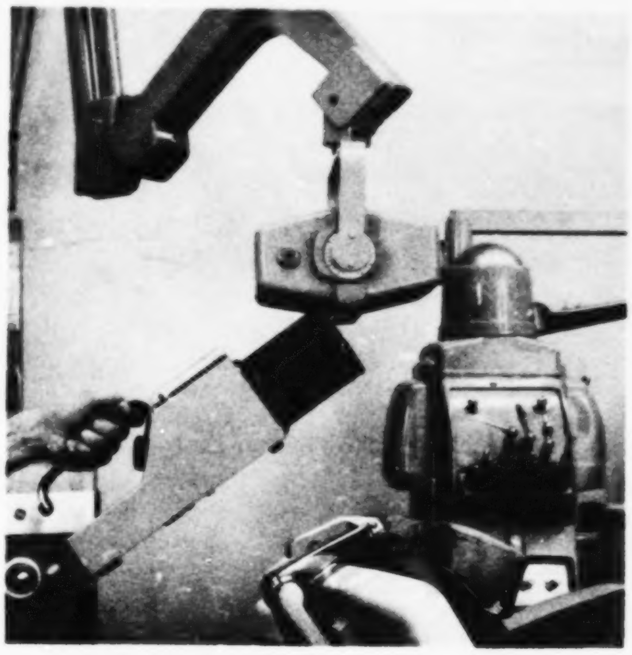
B. AFTER MODIFICATION ______________________ ☐ ☐ ☐ 53 54 55

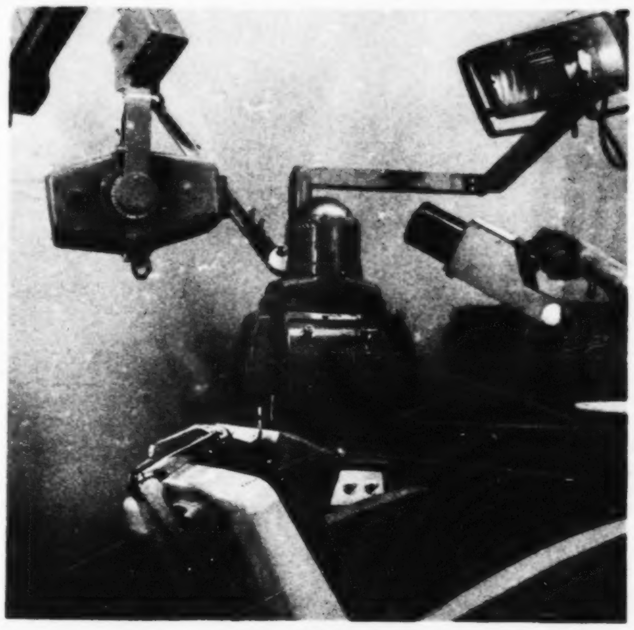
Tubehead Leakage

While the pointer cone is removed, check for tubehead leakage. Leakage radiation is any radiation coming from within the tubehead housing *except* the useful beam. National Bureau of Standards Handbook 76 states that the diagnostic type protective tube housing is an "X-ray tube housing so constructed that the leakage radiation at a distance of *one meter* from the *target* cannot exceed *100 mR* in *one hour* when the tube is operated at any of its specified ratings." The rating of a tube may be specified in terms of "continuous operation" or in terms of individual exposures with a duty cycle. As dental X-ray units are used to make individual exposures, the duty cycle for such exposures must be considered. The X-ray tube duty cycle refers to the period of activation per unit of time that an X-ray tube can be energized without damage to the tube. In other words, the X-ray tube can be operated only a limited number of seconds in each minute without exceeding its safe limits. Exceeding this safe limit may result in "burning out" the tube. In view of this fact, a reading in excess of 100 mR/hr on the Nucor rate meter does not necessarily mean that the X-ray unit fails to meet the leakage requirement because the machine cannot be operated continuously for one hour. Most dental X-ray machines have a duty cycle rating of the order of six seconds for each minute or a duty cycle conversion factor of 1/10. This duty cycle conversion factor multiplied by the rate meter reading gives the actual exposure dose rate from leakage radiation at one meter. If this resultant figure exceeds 100 mR/hr, the X-ray unit does not meet the leakage radiation requirements. A table of duty cycle ratings, conversion factors, and a sample calculation is included in the appendix. (Most dental X-ray machines meet the leakage radiation requirements.)

Place the lead plate over the X-ray tube head port and secure it in place with masking tape. (A small bag of lead shot may be used instead of the lead plate.)





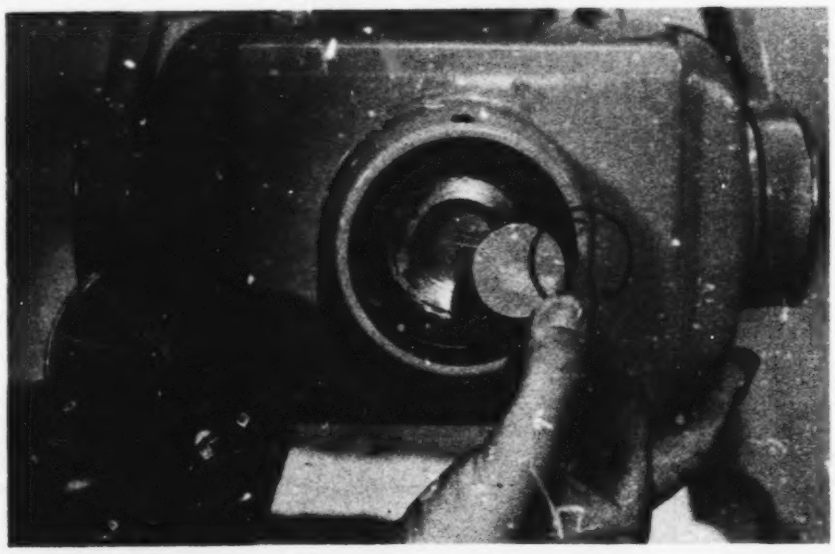


Point the tube head away from the surveyor and any occupied areas, and activate the machine. (CAUTION: Do not exceed the duty cycle limitation during this procedure.) While the machine is operating, make a slow sweep with the Nucor rate meter, around the back and sides of the tubehead, approximately one meter (39") away from the housing. Observe the rate meter while doing this. In particular, check the ends of the tube where the tubehead pivots, since this is one of the most likely areas for the tubehead housing to leak.

Since the response time of these rate meters is rather slow, if an area is found where deflection of the needle increases, it is wise to reread this area without moving the meter during a 2-3 second exposure. Careful consideration should be given to the limitations imposed by the X-ray tube duty cycle before you report that leakage radiation exceeds recommended standards. Your findings are reported as item 22.

22. TUBE HOUSING RADIATION LEAKAGE WITHIN RECOMMENDED STANDARDS
0. NO ____________ 1. YES __________ ☐ 23

Modification of Filtration and Collimation



If, after visual observation and reference to the Dental X-ray Units - General Information chart, it is determined that *additional* filtration is required, the correct amount of filtration may be installed *with the knowledge and consent of the dentist*. (His right to accept or reject the installation is dependent upon the State laws pertaining to the subject.)

The PHS supplies filters in .5 mm. thicknesses of aluminum. Filters are placed closer to the X-ray tube than collimators to reduce scatter radiation to the patient. In some units, additional filtration is installed and secured by a spring clip as shown above, or is held in place by the pointer cone. In other units, it is necessary to use utility wax or masking tape to retain the filters and collimators.

Record total filtration after modification, as item 12B. If no modification is made, enter the same figure in item 12B as appears in item 12A.

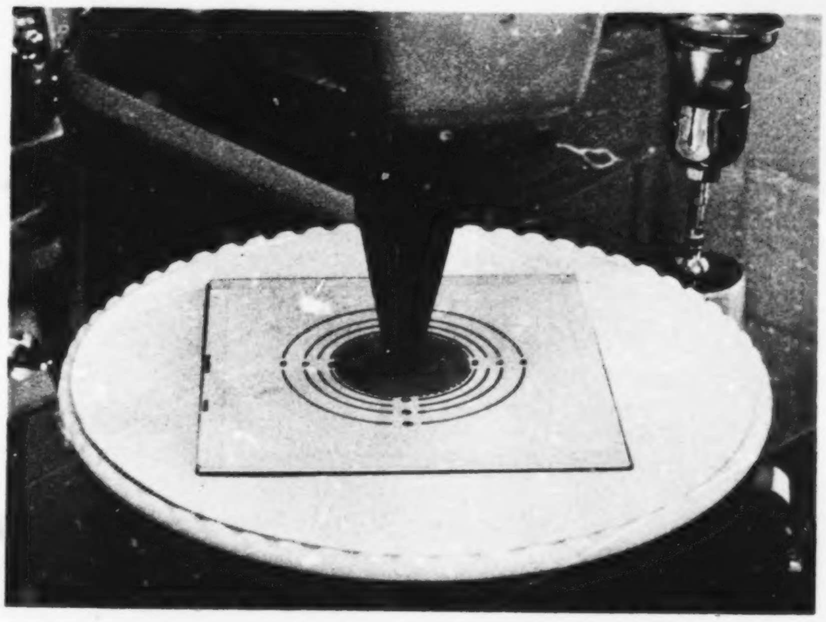
12. TOTAL FILTRATION OF PRIMARY BEAM (mm Al equiv.)

A. BEFORE MODIFICATION ______________ ☐.☐☐ 50 51 52

B. AFTER MODIFICATION ______________ ☐.☐☐ 53 54 55

Collimation of the beam diameter to the recommended 2.75" (or 3", as the case may be) reduces unnecessary radiation exposure by limiting the beam to the area of diagnostic concern. If the beam diameter measurements were excessive, the surveyor may install a suitable collimator or replace an existing collimator with one which has the proper aperture. As with the filters, the consent of the dentist should be secured before installation. (The PHS supplies collimators for the five most commonly used dental X-ray units but only for short pointer cones. Refer to appendix for a method to calculate aperture sizes of collimators for long cones and other units.)

Replace the pointer cone. If a new collimator has been inserted, recheck the beam diameter with the fluorescent screen to be certain that the beam is the correct size (2.75") and properly centered, as illustrated below.



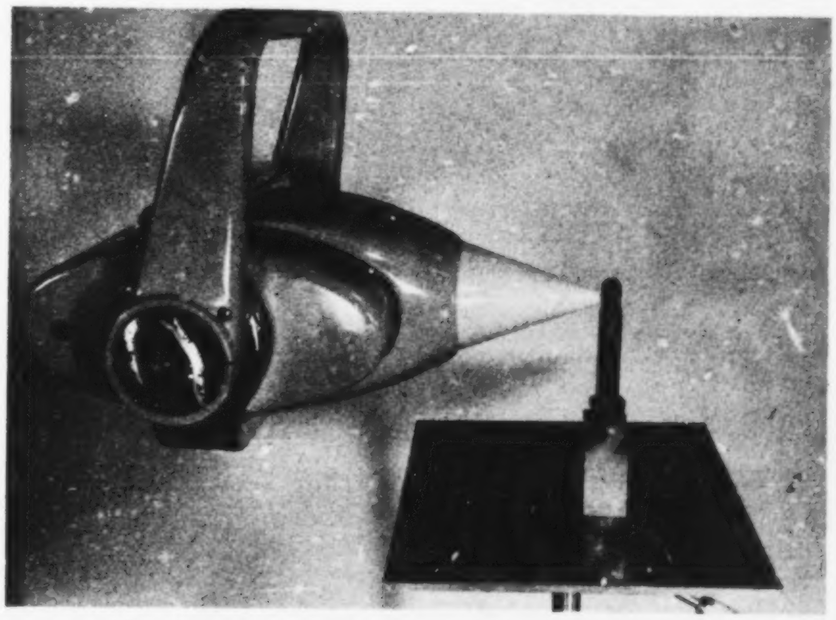
Enter the modified beam diameter as item 11B. If the beam diameter is within recommended limits or cannot be modified, enter the information recorded in item 11A in item 11B.

11. FIELD DIAMETER AT END OF POINTER CONE (inches)

A. BEFORE MODIFICATION ______________________ ☐☐☐ 44 45 46

B. AFTER MODIFICATION ______________________ ☐☐☐ 47 48 49

If additional filtration is inserted, determine the new Roentgen output and record as item 13B. If no filtration is added, enter the figures recorded in item 13A in item 13B.



13. ROENTGEN OUTPUT AT END OF POINTER CONE IN r/sec.

A. BEFORE MODIFICATION ______________________ ☐☐☐ 56 57 58

B. AFTER MODIFICATION ______________________ ☐☐☐ 59 60 61

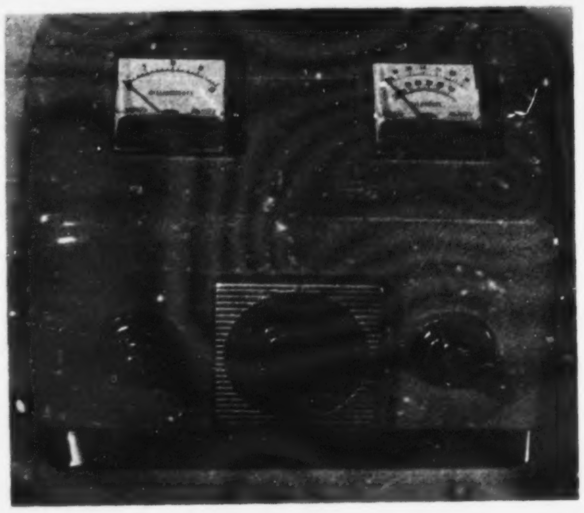
Is X-ray Unit Operable at Least 6 Feet from Tubehead

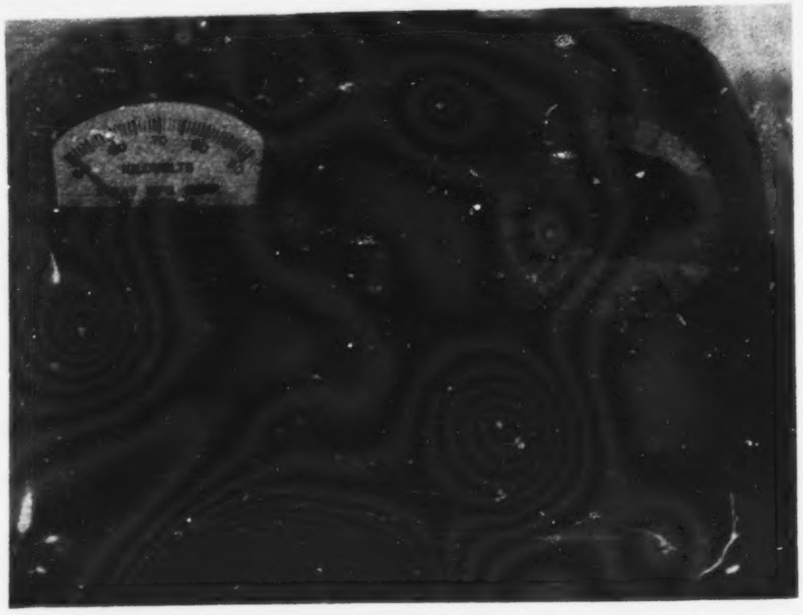
For item 14, the point to be determined is whether *the operator can stand at least six feet away from the tubehead while operating the equipment*, assuming that the tubehead is positioned around the headrest of the chair. The findings are entered as item 14.

14.IS X-RAY UNIT OPERABLE AT LEAST 6 FEET FROM TUBE HEAD ☐
0. NO ________ 1. YES ________ 62

Timer

Mechanical and electronic timers are, in general, easily distinguished. Invariably the control setting for electronic timers is located on the console. (The exception to this is the older X-ray machine that has been modified by installation of an electronic timer.) The electronic timer control is calibrated to read in fractions of a second and is adjustable for settings as low as 1/30 or 1/60 of a second. The hand control to activate the X-ray machine consists of a button switch which must be held down until the timer completes the preset exposure time. Most electronic timers automatically reset themselves after the completion of the pre-set exposure or any part thereof. In order to determine whether or not the timer terminates the exposure, observe the milliamperage indicator (for both electronic and mechanical timers) while you hold the button down at the end of the timing cycle. The milliamperage indicator operates only when the machine is activated. At present, there is no convenient means of checking the accuracy of electronic timers when surveying dental X-ray equipment in the dental office. For electronic timers, item 19C, box 20, is recorded as C - Not applicable. Also, electronic timers cannot be operated without simultaneously energizing the tube.





19. TIMER

A. TYPE 0. NONE______ 1. MECHANICAL______ 2. ELECTRICAL OR ELECTRONIC______ ☐ 18

B. TERMINATES EXPOSURE

0. NO ______ 1. YES ______ B. UNKNOWN ______ ☐ 19

C. STOPWATCH CHECK

TIMER SETTING ________ STOPWATCH READING ________ DIFFERENCE ☐ 20

Mechanical timers consist of a hand-held clockwork mechanism with a dial setting calibrated in seconds and a control button to activate the timer. With some mechanical timers, it is necessary to turn the setting indicator past a certain point in order to cock the clockwork mechanism, and then turn back to the desired time setting. The button must be held *firmly* throughout the exposure in order to complete the preset exposure time. If a dental X-ray machine has no milliamperage indicator, observe the fluorescent screen to determine if the timer terminates the exposure. This can be done while measuring beam diameter.)

Generally speaking, older mechanical timers are not consistently accurate at time intervals of less than one second. The stopwatch check is performed *by turning off the machine* and setting the timer to its maximum indicated time interval. Start the timer and the stopwatch simultaneously, holding one in each hand, and trip the stopwatch again when the timer snaps off. This procedure sometimes requires a little practice since it is necessary to keep the timer button depressed and to release the stopwatch button while the timer is operating. Record the times and note the difference as item 19C. (This method will only detect gross inaccuracies, severe inaccuracies may affect the calculated Roentgen output values.)

X-ray Unit Grounded

It is desirable to have X-ray units properly grounded to eliminate any shock hazard to patients and dental personnel. Checking to see if the X-ray unit is grounded has proved to be undeterminable in many cases. The presence of a three-prong plug does not prove anything since most X-ray units come so equipped. The presence of a three-hole female wall receptacle does not necessarily mean that the outlet is properly grounded since these are very easily installed without proper grounding. Most dentists do not know for certain if the outlet has been properly grounded. Unless there is definite visible evidence of proper grounding, or you have a means for checking electrical grounds, it is advisable to record item 20 as B - Unknown.

20. X-RAY UNIT GROUNDED

0. NO ________ 1. YES ________ B. UNKNOWN ________ ☐ 21

Stability of Tubehead

Tubehead stability refers to the ability of the tubehead to maintain a desired position without moving. An unstable tubehead that drifts or changes position while X-rays are being taken can be responsible for many retakes because of blurred radiographs. Such retakes constitute unnecessary radiation exposure to patients and dental personnel. Also, dental personnel operating the equipment may be tempted to hold the tubehead to prevent it from drifting during the exposure, which would result in their receiving unnecessary radiation.

Tubehead stability is checked by extending the tubehead and seeing if it will stay in place without drifting. This should be done in positions that may be encountered during X-ray procedures. (CAUTION: Some of the mobile X-ray equipment will tip if the tube head is fully extended to one side or the other.) If the tubehead will not hold its position with reasonable stability, it is considered *not adequate*, Record your findings as item 21.

21. STABILITY OF TUBE HEAD

0. ADEQUATE ________ 1. NOT ADEQUATE ________ ☐ 22

SCATTER RADIATION DEMONSTRATION PROCEDURES

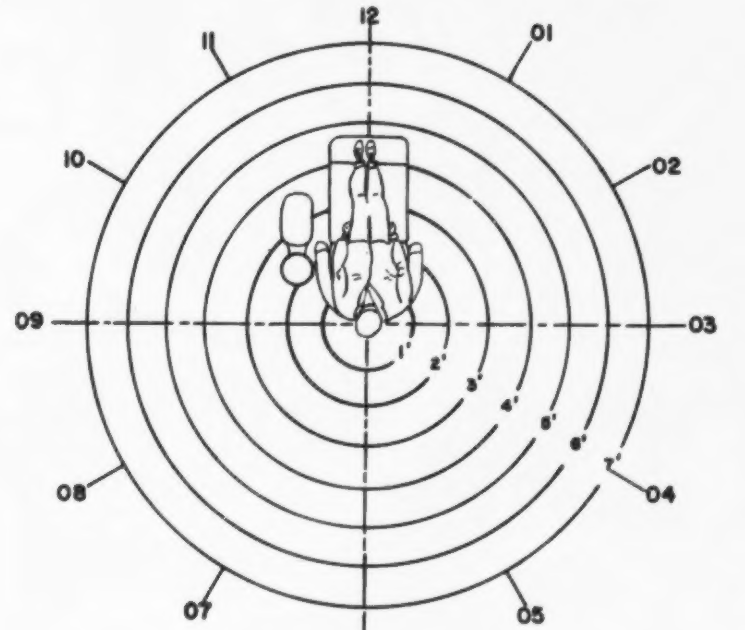
29. OCCUPATIONAL EXPOSURE; SCATTER RADIATION

The third page of the survey form is best completed by the physical surveyor and the interviewer working together. This procedure is designed primarily as an educational demonstration to the dentist and his personnel in order to assist them in reducing any unnecessary radiation exposure.

The demonstration is essentially a matter of taking rate meter readings of scatter radiation at the positions in which the dentist and/or his assistant normally stand, using three of the most commonly used dental X-ray exposures. If the exposure to the dentist or his personnel is measurable or more than a very slight amount, the survey team demonstrates how to reduce their exposure. This is done by effective utilization of existing structural features of the office or by increasing the distance from the source of radiation.

A phantom is filled with water and placed on the backrest of the dental chair. The headrest is adjusted to support the phantom at the approximate height and angulation of a seated patient's head. (Since the human body is approximately 90% water, the phantom full of water results in a similar scatter radiation pattern.)

In order to standardize the recording of positions and distances, the patient's head (the phantom) is envisioned as the center of a clock, facing 12 o'clock.

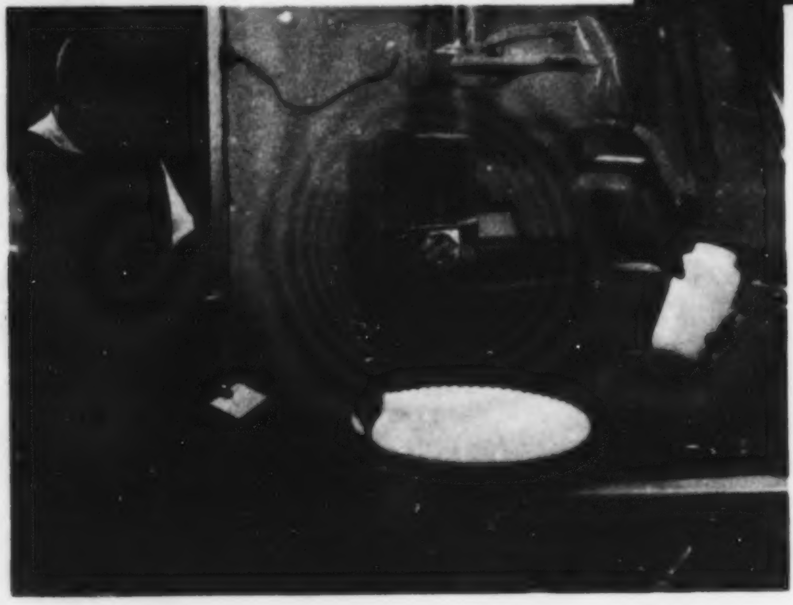


The illustration at the left shows this concept diagrammatically. Even if the chair is normally rotated in relation to the cuspidor, the direction of the patient's head is the indicator which determines the 12 o'clock position.

The three dental exposures which are used for demonstration purposes are (I) right bitewing exposure, (II) anterior upper periapical exposure, and (III) left bitewing exposure.

Anterior Upper Periapical Exposure

The correct positioning for the upper anterior periapical exposure is with the tubehead directed downward at an angle of approximately 45° and aimed at the center of the phantom, i.e., from 12 o'clock toward 6 o'clock. If the dentist is readily available, it is advisable to ask him to position the tubehead.

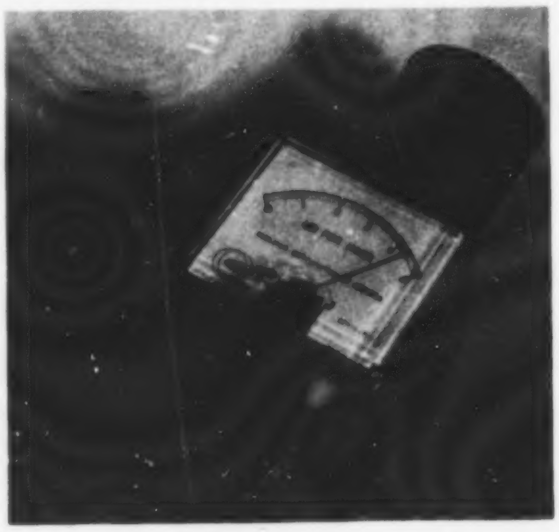


After positioning the tubehead for this exposure, the survey team asks the dentist where he and his assistant normally stand during this exposure. The physical surveyor, wearing the lead apron, measures the scatter radiation in the dentist's position. The recorder notes the direction, distance, and mR/hr at this position. The surveyor repeats the procedure standing in the assistant's position. The recorder enters the findings under "At Normal Operating Position" in item 29-II.

II ANTERIOR UPPER PERIAPICAL EXPOSURE

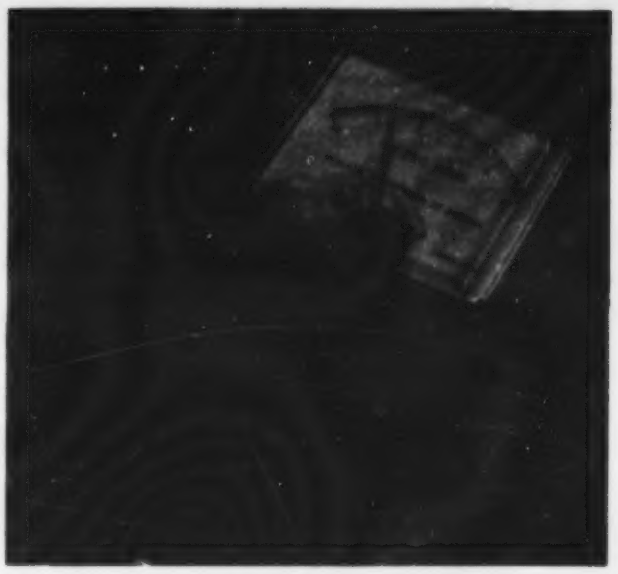
	DIRECTION	DISTANCE	mr/hr	mr/hr
C. DENTIST	☐☐ 38 39	☐ 40	☐☐☐☐ 41 42 43 44	☐☐☐ 45 46 47
D. ASSISTANT	☐☐ 48 49	☐ 50	☐☐☐☐ 51 52 53 54	☐☐☐ 55 56 57

Throughout this procedure it is advisable to invite the dental personnel to observe the indicator needle during the scatter radiation measurements. (Consideration must be given to the duty cycle of the X-ray tube and to the response time of the rate meter during these procedures. In most instances, two- or three-second exposures are adequate to satisfy both requirements.)



The surveyor then selects new locations which offer improved protection and takes scatter radiation readings. The new positions are determined by the physical layout of the office and may include such changes as stepping behind an available wall, increasing the distance from the tubehead, standing in a different location, or utilizng a protective barrier. A number of readings may be required to find new locations which will best reduce unnecessary radiation exposure.

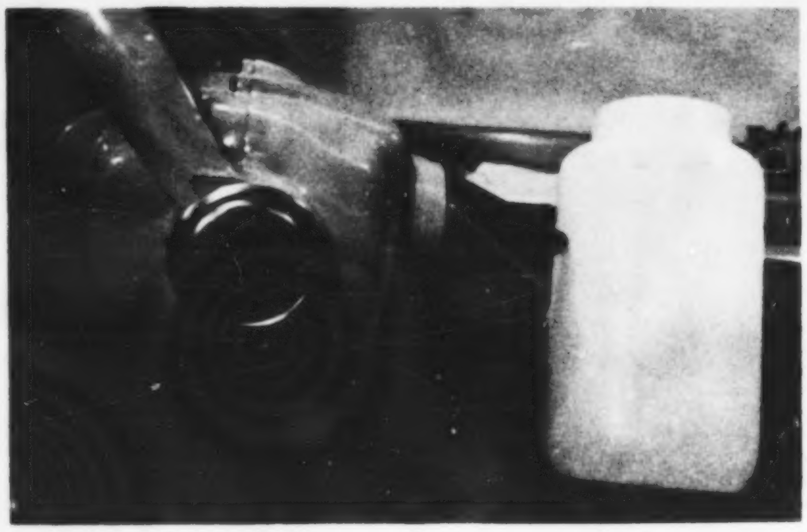
Readings are obtained for the dentist's new position and the reduction demonstrated to him. The illustration at the right shows an appropriate lower reading when taken at the new position. This visual observation of the reduction in scatter readings between the old and new positions is a highly effective educational technique. It is advisable to explain briefly the significance of the various scale settings on the rate meter to the dentist and his staff. The scale settings are essentially a sensitivity range selection. Care should be taken to point out that if the scale setting is on any other setting than xl (times one), the dial reading must be multiplied by the scale setting to obtain the correct reading.

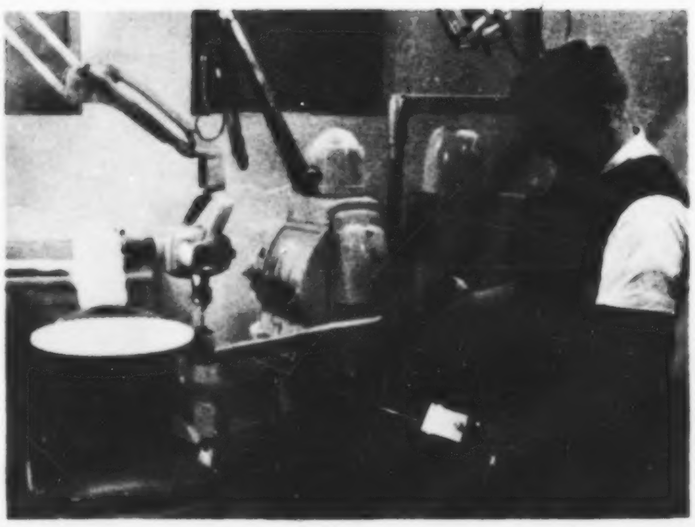


The demonstration of the reduction in exposure is repeated at the assistant's position and recorded under "At New Position" in item 29-II.

Right and Left Bitewing Exposures

The picture below shows the phantom and the tubehead properly positioned for a right bitewing exposure. The right and left bitewing exposure positions have similar tubehead positioning from opposite sides of the patient. The tubehead is angled downward approximately 8^{0} and directed slightly backward--from 2 o'clock toward 8 o'clock for the right bitewing and from 10 o'clock toward 4 o'clock for the left bitewing.

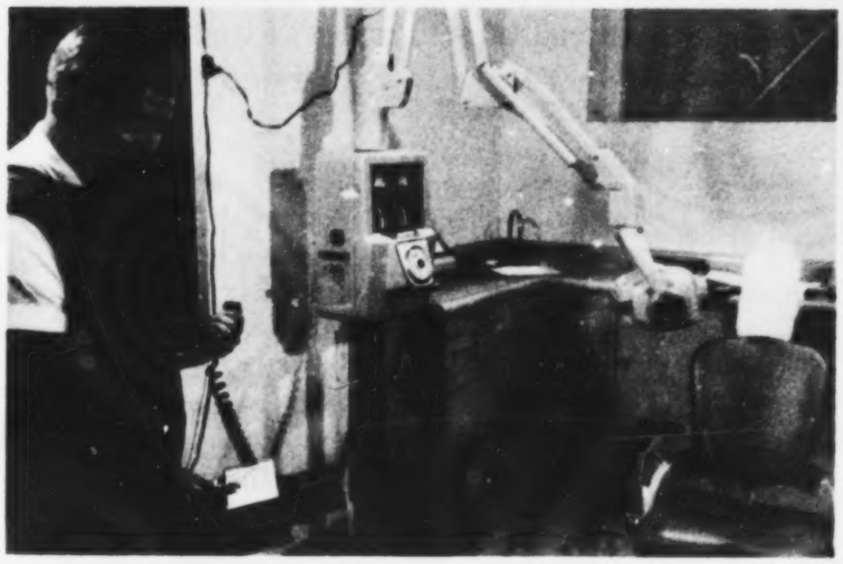




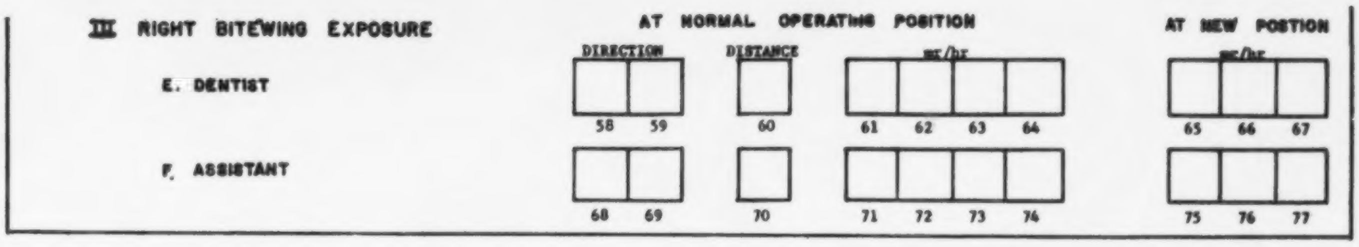
Following the procedures used for the upper anterior periapical exposure, scatter radiation is determined for a left bitewing exposure at the dentist and dental assistant positions. Enter findings as item 29-I.

29. OCCUPATIONAL EXPOSURE; SCATTER RADIATION (REFER TO DIAGRAM BELOW).

	AT NORMAL OPERATING POSITION			AT NEW POSTION
I LEFT BITEWING EXPOSURE	DIRECTION	DISTANCE	mr/hr	mr/hr
A. DENTIST	☐☐ 18 19	☐ 20	☐☐☐☐ 21 22 23 24	☐☐☐ 25 26 27
B. ASSISTANT	☐☐ 28 29	☐ 30	☐☐☐☐ 31 32 33 34	☐☐☐ 35 36 37



The tubehead is placed in position for a right bitewing exposure. The same procedure is repeated as before, and the findings entered under "At Normal Operating Position" in item 29-III.



III RIGHT BITEWING EXPOSURE	AT NORMAL OPERATING POSITION			AT NEW POSTION
	DIRECTION	DISTANCE	mr/hr	mr/hr
E. DENTIST	☐☐ 58 59	☐ 60	☐☐☐☐ 61 62 63 64	☐☐☐ 65 66 67
F. ASSISTANT	☐☐ 68 69	☐ 70	☐☐☐☐ 71 72 73 74	☐☐☐ 75 76 77

New recommended positions are determined, readings obtained and demonstrated, and these findings entered under "At New Position" in items 29-I and 29-III. If the dentist's techniques and operating procedures are such that no modifications are necessary, enter C-Not applicable, in the "At New Position" column in item 29. If the dental assistant does not participate in the taking of X-rays, rows B, D, and F are entered as C.

Consultation

After completing the scatter radiation demonstration, be prepared to spend a few minutes talking with the dentist or his assistant. If they exhibit interest, try to answer their questions insofar as you are qualified, or suggest a source that can aid him. A *good* dental X-ray survey consists of more than installing filters and collimators and filling out a survey form; it involves educating the dentist and his staff to good radiation hygiene practices. So if the opportunity presents itself, be prepared to spend a few minutes in an educational effort. You will find that it will make surveying dental X-ray equipment much more interesting. If you feel that further consultation is to be recommended, enter as item 17.

17. FURTHER CONSULTATION RECOMMENDED
0. NO ____ 1. YES (SEE REMARKS) ________ ☐ 69

Try to have a supply of educational literature with you for distribution. We suggest that you leave a copy of Radiation Protection for Dentist and Patient (Public Health Service Publication No. 885) at each office.

When the equipment is packed and you are ready to leave, be sure to thank the dentist and his personnel for their time and interest. Note the time and date the survey was completed, and enter as items 15 and 16.

15. TIME
SURVEY BEGAN ____________ SURVEY ENDED ______________ DIFFERENCE IN MINUTES ☐☐ 63 64

16. DATE OF SURVEY
(MONTH/DAY/YEAR) ________________________ ☐☐☐☐ 65 66 67 68

After the survey is completed, the survey form should be coded in accordance with the Coding and Punching Instructions. *All boxes must be filled in with the proper numbers or coding. It is important that this be done as soon as possible.* Almost invariably a busy survey team will find they have neglected to record some obvious items of information. If the forms are coded soon after the survey was performed, it is usually possible to remember unrecorded information or, if necessary, to obtain it by other means. This is particularly true of survey teams in the field that may be moving from town to town or from area to area.

APPENDIX

X-Ray Equipment

X-Ray Film

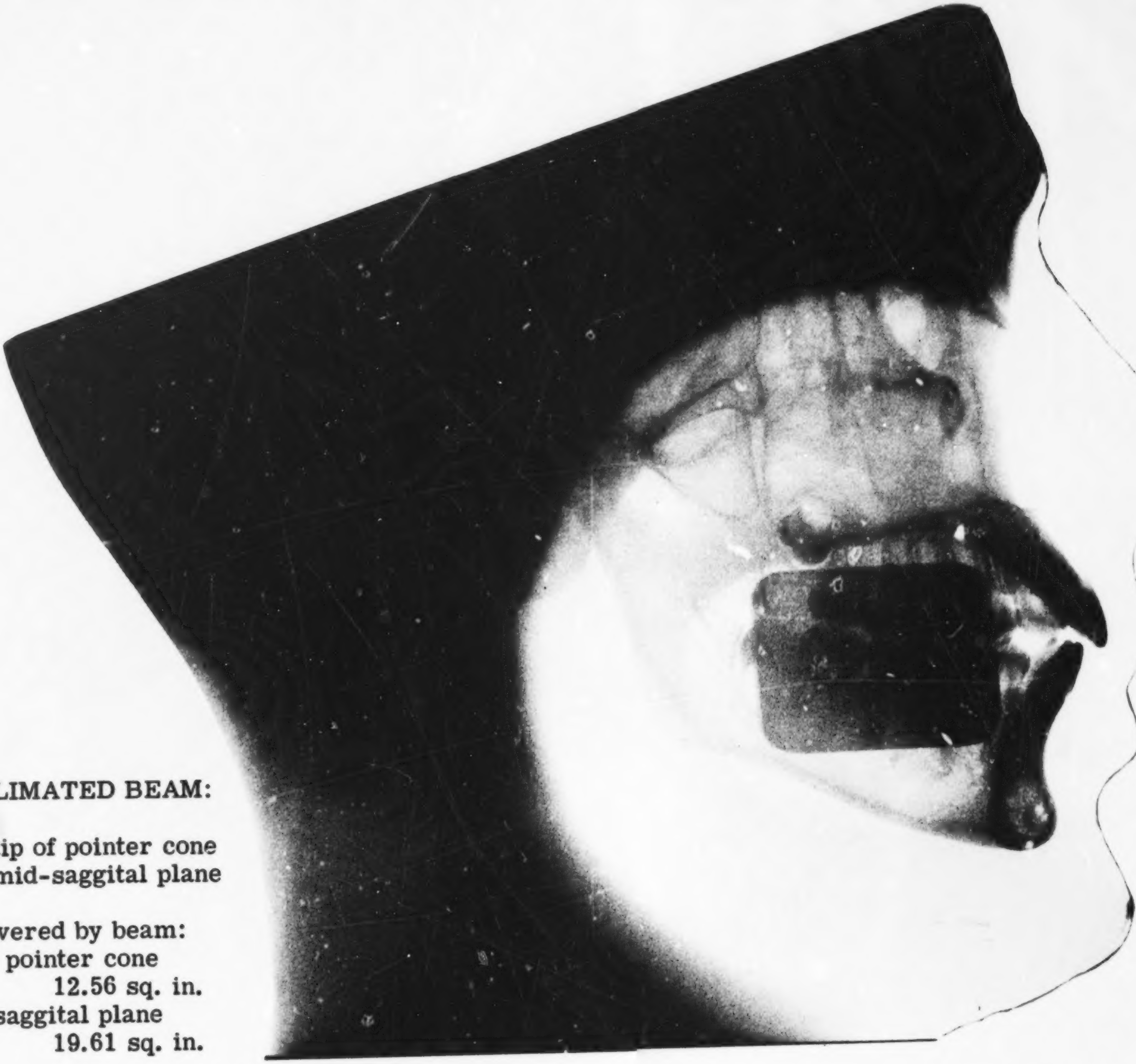
Film Badge Service

Calculations

Protective Accessories

Sample Form

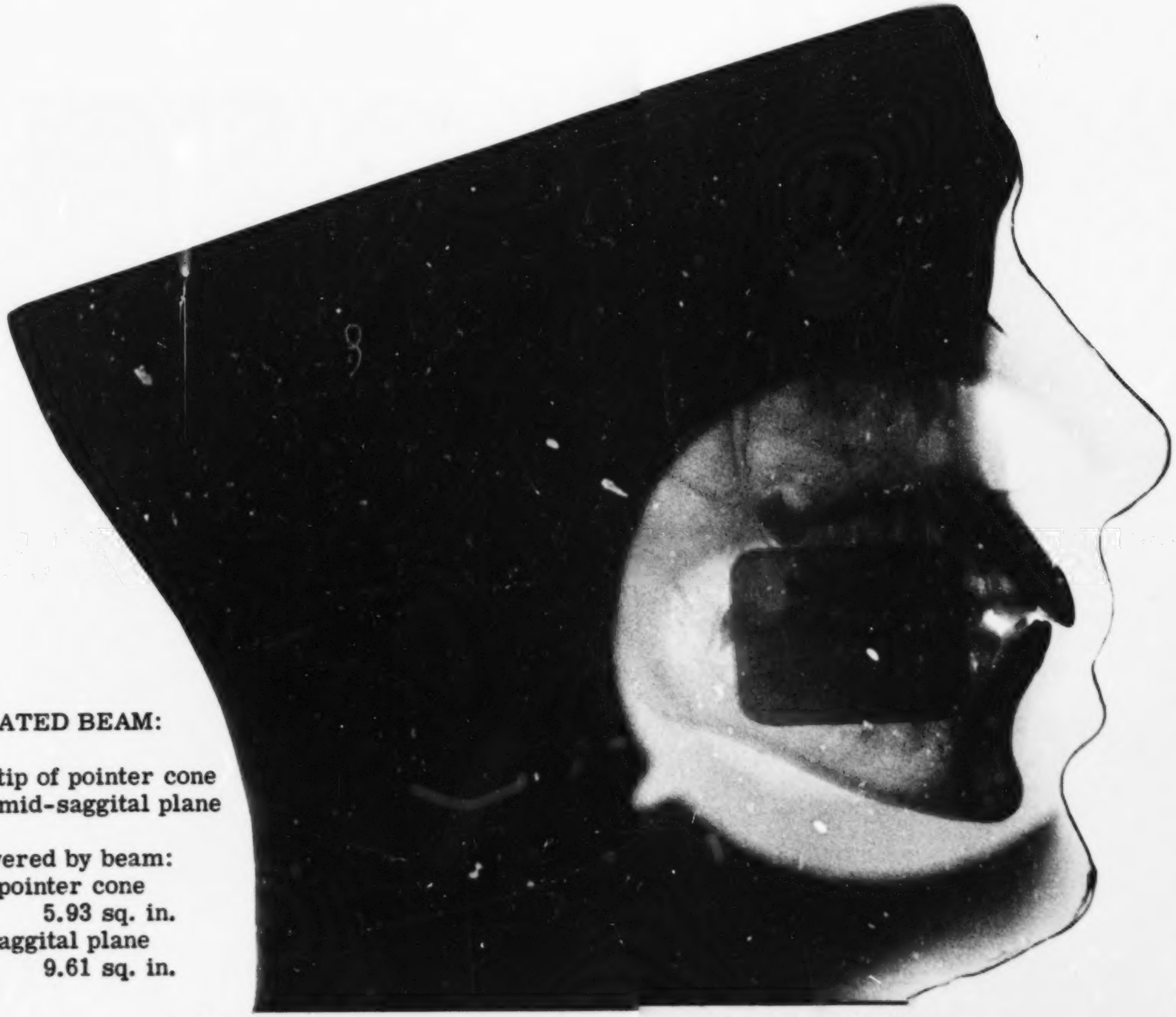
Punching and Coding



UNCOLLIMATED BEAM:

4.0" at tip of pointer cone
5.0" at mid-saggital plane

Area covered by beam:
at tip of pointer cone
12.56 sq. in.
at mid-saggital plane
19.61 sq. in.



COLLIMATED BEAM:

2.75" at tip of pointer cone
3.50" at mid-saggital plane

Area covered by beam:
at tip of pointer cone
5.93 sq. in.
at mid-saggital plane
9.61 sq. in.

At the mid-saggital plane the collimated beam represents a 49.0% reduction of area exposed by the uncollimated beam.

General Information

Manufacturers

Illustrations

Electronic Timers

DENTAL X-RAY UNITS - GENERAL INFORMATION

Manufacturer	Model	Date of Manufacture	Maximum kvp	Rating ma	Approximate Inherent Filtration mm.Al equiv.	Focal Spot to Tip of Cone (in.)	Added Al (mm.) Filtration Recomm.
Ritter	A	1921 - 1933	63	10	0.50	7	1.5
	B	1933 - 1950	65	10	0.50	7	1.5
	D	1950 - 1956	70	15	0.50	7	1.5
	E	1956 - 1959	90	15	2.05	7	0.5
	F	1959 - 1962	90	15	2.05	7	0.5
	G	1962 -	90	15	2.55	7	---
	75	1966 -	75	15	2.50	7	---
General Electric	Victor CDX	1923 - 1933	53	10	0.90	8	1.0
	CDX-E	1933 - 1954	65	10	1.40	8	0.5
	GE-70	1955 - 1958	70	10	1.50	8	0.5
	GE-90	1955 - 1958	90	15	1.50	8	1.0
	GE-70-II	1959 -	70	10	1.50	8	0.5
	GE-90-II	1959 -	90	15	*2.55	8	---
	GE-73	1965 -	70	10	1.50	8	0.5
	GE-100	1965 -	100	15	2.50	8	---
*1.5 mm Al below Serial No. 605738							
Weber	5,6,7,7A,9		65	10	0.50	6.25	1.5
	6R,11R		70	15	0.50	7	1.5
	90		90	15	1.50	6.25	1.0
	12R		90	15	2.50	7	---
X.R.M.	1B,2A,&3A	1939 - 1957	70	15	0.75	5.5	1.5
	2B,3B		60	15	2.00	5.5	---
	90		90	15	2.00	5.5***	0.5
Philips	A & B	1948 - 1959	45	5	1.00	4	1.0
Oralix	C		45	5	2.00	4	---
Norelco	(50)D	1960 -	50	7	2.00	4	---
Siemens*	Heliodent		50	7	2.00	4	---
	Heliosphere		72	12	2.00	6	0.5
Wm. Meyers*	A		90	15	0.50	6	2.0
Fischer	(open-tube)				0.50	---	1.5
	(closed-head)	Discont'd 1952	65	10	0.50	---	1.5
Grenz-Ray					1.00	7	1.0
Profexray Inc.	MD-2A & MD-3A		60	10	1.70	7.5	0.5
Westinghouse**			65	10	0.70	6.25	1.5
Universal	(open-tube)						
	U-2550 (closed-head)	1955	63	10	2.00	8	---

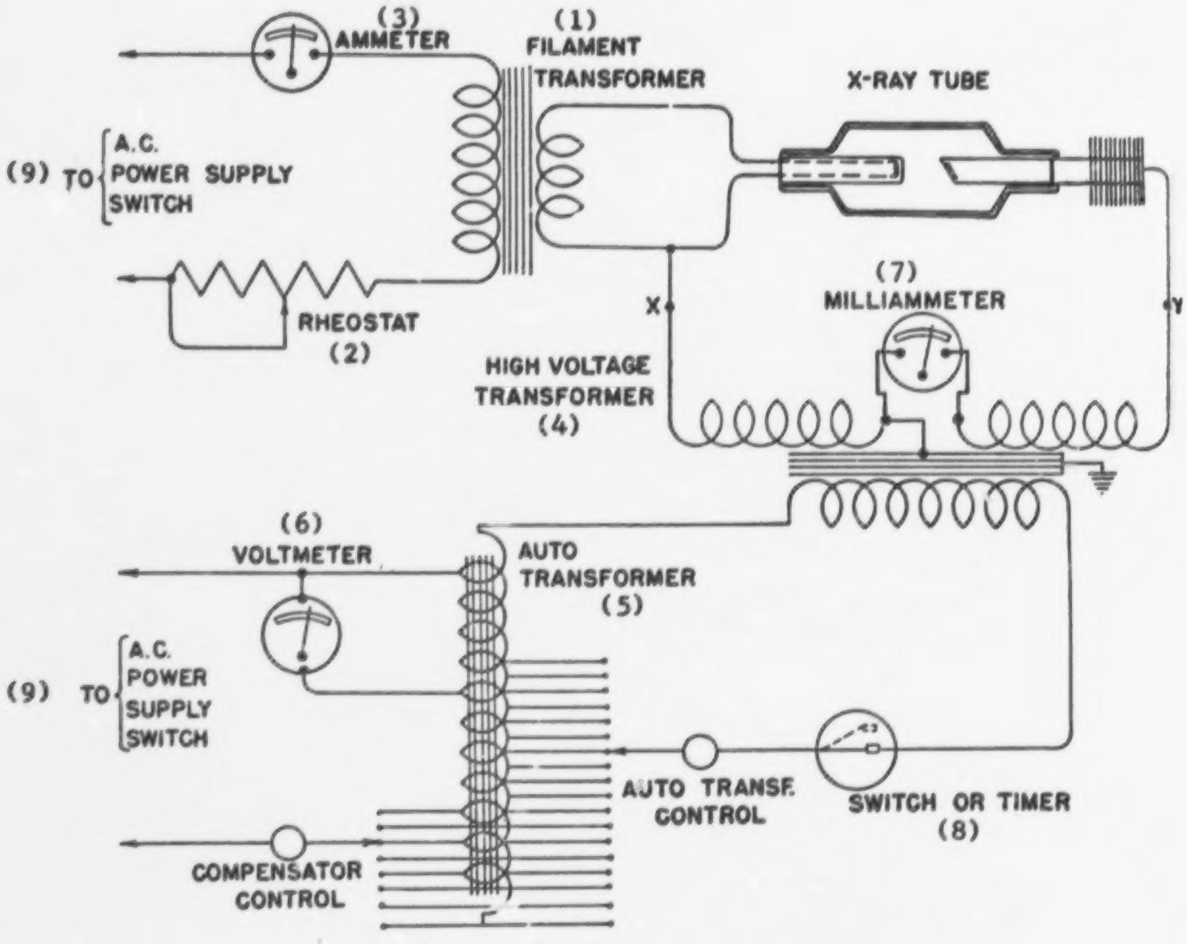
* No longer manufacture dental equipment

** Manufactured by X.R.M. for Westinghouse

*** Spacer available to increase to 7"

TYPICAL DENTAL X-RAY CIRCUIT

Basic elements of a self-rectified circuit for the generation of X-ray


(3) AMMETER
(1) FILAMENT TRANSFORMER
X-RAY TUBE
(9) TO A.C. POWER SUPPLY SWITCH
RHEOSTAT (2)
X
(7) MILLIAMMETER
Y
HIGH VOLTAGE TRANSFORMER (4)
(6) VOLTMETER
AUTO TRANSFORMER (5)
(9) TO A.C. POWER SUPPLY SWITCH
AUTO TRANSF. CONTROL
SWITCH OR TIMER (8)
COMPENSATOR CONTROL

1. Filament transformer to supply heating current to the filament of the X-ray tube.
2. A rheostat for controlling the filament current.
3. An ammeter for indicating the filament current (usually omitted in modern apparatus).
4. A transformer to supply necessary voltage for electron acceleration (high voltage transformer).
5. An autotransformer for controlling the accelerating voltage.
6. A line voltage compensating control indicating voltmeter.
7. A milliammeter for indicating tube current.
8. A switch for initiating and terminating the X-ray exposure.
9. A line switch for disconnecting the entire apparatus from its power supply.

MANUFACTURERS OF DENTAL X-RAY EQUIPMENT
(Addresses given where known)

Presently making equipment

General Electric Company, 4855 Electric Avenue, Milwaukee, Wisconsin.
North American Philips Co., Inc., Norelco Medical and Dental Division, 100 East 42nd Street, New York, New York 10017
Profexray, Inc., Maywood, Illinois.
Ritter Company, Inc., Rochester 3, New York.
Siemens America Inc., Dental Division, 10-39 44th Drive, Long Island City 1, New York.
Universal, 1138 North Western Avenue, Chicago, Illinois.
XRM, Community Drive, Great Neck, New York 11021.
Weber, 2206 13th, N.E., Canton, Ohio

No longer making dental X-ray equipment

Adams
A. S. Aloe Company, Continental Pace Maker MX-F-8435, 1831 Olive, St. Louis, Missouri.
Edwards
Englen
H. G. Fischer, 9451 West Belmont Avenue, Franklin Park, Illinois.
Grenz-Ray
Humphrey
International
Liebel Flarsheim Co., 111 Amity Road, Cincinnati, Ohio.
Mattern
G. M. McFedrier
Meyer, Chicago, Illinois.
Pengelly
Philberg
Picker X-ray Corporation, Waite Manufacturing Division, Inc., Cleveland, Ohio
Pony
Professional Equipment Company
Standard, 1933 North Burling, Chicago, Illinois
Thomas Plaster Company
X-Cell-Ray
Waite and Bartlett
Wappler
Westinghouse, 2521 Wilkens Avenue, Baltimore, Maryland.

MAKE : General Electric

MANUFACTURER: General Electric Company
4855 Electric Avenue, Milwaukee 1, Wisconsin

MODELS : The General Electric Company has produced essentially five different series of dental X-ray models. The first one they marketed was the Victor-CDX model, which was engineered and marketed by the Victor Company, beginning in 1923. General Electric purchased the Victor Company and continued the Victor CDX unit until 1933. At that time they produced the G. E. CDX Model E X-ray unit, which was marketed until 1954. Since 1955, the General Electric Company has marketed two dental X-ray units—a 70 kV unit and a 90 kV unit—and in 1965 added a 100 kV unit to their line of dental X-ray models.

FILTRATION & COLLIMATION : The Victor CDX models manufactured from 1923 to 1933 came equipped with an open-end cast-iron cone, which restricted the primary beam of radiation to a 4-½" diameter circle at a distance of 8" from the focal spot. The inherent filtration of the Victor CDX unit was 0.6 to 0.9 mm. aluminum equivalent. Additional filtration was not supplied at the time of manufacture, but can be installed by taping one or more 0.5 mm. Al discs over the small aperture of the cast-iron cone. Order Part No. 1005341 P1 to obtain the 0.5 mm. A1 discs.

The CDX Model E unit has a total inherent filtration equivalent to 1.0 to 1.4 mm. aluminum. Additional filtration was not originally supplied with the CDX-E units but is now available in 0.5 mm. A1 discs which may be ordered by requesting Part No. T4007A. These discs can be retained in place by the three screws which hold the lead diaphragm in position.

The GE-70 and 70 II units come equipped with a pointed plastic cone (Catalog No. 2001444G2), which provides an 8" distance from the focal spot to cone tip. An integral part of this cone is a lead diaphragm with a 3/4" aperture which restricts the primary beam of radiation to a 3" diameter at cone tip distance. An optional transparent open-end cone (Catalog No. E6304A) is available and provides a 16" distance from the focal spot to the end of the cone. This cone contains a lead diaphragm with a 3/8" aperture which restricts the primary beam of radiation to a 3" diameter at a distance of 16" from the focal spot.

On the 70 kV units there is a built-in filtration equivalent to 1.5 mm. aluminum. Additional 0.5 mm. A1 filters (Part No. 1005341P1) are available and are easily installed by means of a retaining ring (Part No. 508AZ5691).

The GE-73 unit comes equipped with an open plastic cone (E6304D) which provides an 8" distance from the focal spot to the end of cone. An integral part of this cone is a lead diaphragm that restricts the primary beam of radiation to a 2 3/4" diameter at the end of the cone. A scatter guard is also built into this open cone for further patient and operator protection.

Optional transparent open cones with scatter guard and lead diaphragms (that restrict the primary beam to 2 3/4" at cone end) are available. They provide either a 12" or 16" focal spot to end of cone distance. (Catalog No. E6304E for the 12" cone and E6304F for the 16" cone.)

The Model GE-73 has built-in filtration equivalent to 1.5mm. Al. (two 0.5 mm. Al filters are also supplied with each unit if additional filtration is required.)

G.E. 90 units come equipped with a pointed plastic cone (Part No. 2001444G2), which provides an 8" distance from the focal spot to cone tip. This cone has a built-in lead diaphragm with a 3/4" aperture which restricts the primary beam of radiation to a 3" diameter at cone tip distance. As was the case with the 70 kV unit, the 90 kV unit has available an optional long cone, which provides a 3" diameter beam of radiation at a distance of 16".

Older G.E. 90 units have a built-in filtration of 1.5 mm. aluminum equivalent. Two additional 0.5 mm. Al. filters (Part No. 1005341P1) are initially supplied with each unit and are easily secured with a retaining ring (Part No. 508A256P1).

On the G.E. 90-II units there is a built-in filtration equivalent of 2.55 mm. Al. It is noteworthy, also, that recently General Electric has taken further steps to reduce the primary beam diameter at cone tip distance. New units have a primary beam diameter at cone tip of 2-3/4" or less.

All G.E. 90-II units below Serial No. 605738 have built-in filtration of 1.5 mm. aluminum equivalent. They were manufactured to comply with recommendations of Bureau of Standards Handbook 60, the predecessor of Handbook 76. Since 1955, G.E. has provided two 0.5 mm. aluminum filters in a plastic bag with each 90 kV unit shipped. One of these should be added, to bring units below serial No. 605738 into compliance with Handbook 76.

The GE-100 unit comes equipped with an open plastic cone (E6304D) which provides an 8" distance from the focal spot to the end of cone. An integral part of this cone is a lead diaphragm that restricts the primary beam of radiation to a 2 3/4" diameter at the end of the cone. A scatter guard is also built into this open cone for further patient and operator protection.

Optional transparent open cones with scatter guard and lead diaphragms (that restrict the primary beam to 2 3/4" at cone end) are available. They provide either a 12" or 16" focal spot to end of cone distance. (Catalog Number E6304E for the 12" cone and E6304F for the 16" cone.)

The Model GE-100 has built in filtration equivalent to 2.5 mm. Al. (two 0.5 mm. Al filters are supplied with each unit if additional filtration is required.)

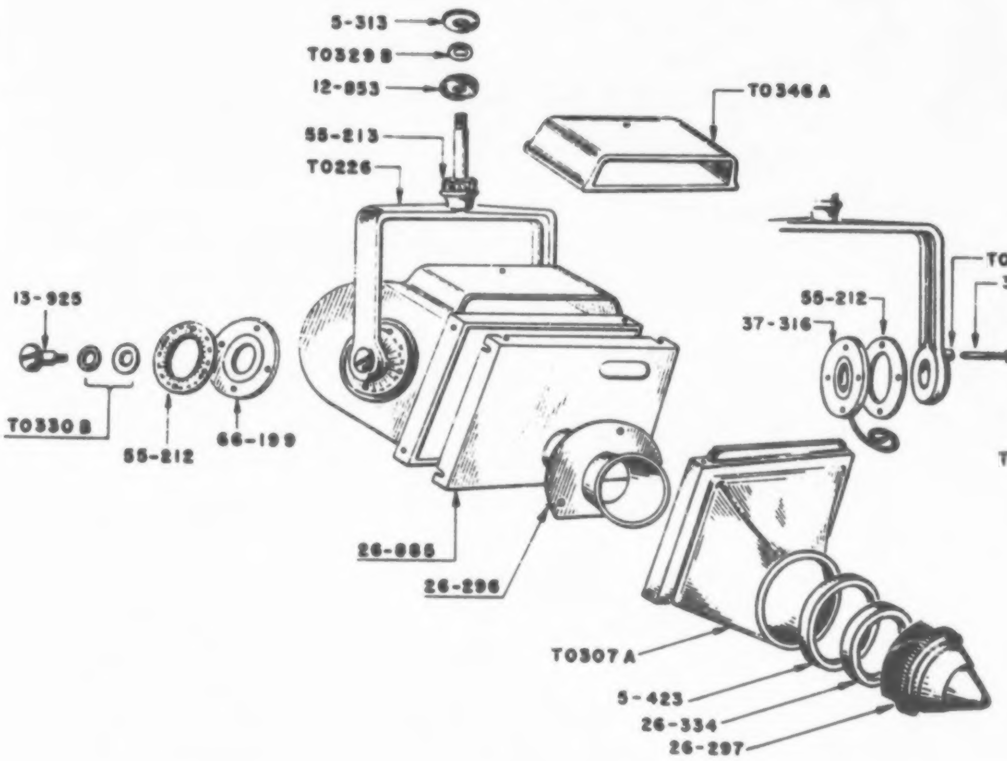
LOCATION OF TUBE NO. : The tube serial numbers on the Victor CDX units and the CDX Model E units are on a table pasted to the inside cover of the stabilizer housing of the tubehead. The stabilizer part number is T0346A. This part is held in place by one screw and can easily be removed. If the paper tag is illegible or absent, the serial number can be obtained from the Bakelite cover plate that seals the oil in the tubehead. This number is more difficult to find because it requires the removal of the head cover (TO307A). Removal is accomplished by taking out a screw at each of the four corners of the cover plate. (We do not recommend this procedure because of the possibility of damage to the oil seals.)

The tubehead serial numbers on the later 70 kV units and the 90 kV units are easily viewed on a plate attached to the outside top surface of the tubehead housing.

CONSOLE SERIAL NO. : The Victor CDX and G.E. CDX Model E units have their console serial numbers on a metal plate that is easily visible at the bottom center of the console control box. (The G.E. 90-II has a metal plate on the left side of the console near the on-off switch.) The G.E. 70-II unit has the serial number on the right side near the bottom of the console.

GENERAL INFORMATION : Should it become necessary to obtain the tubehead serial number of the CDX or CDX Model E units, the illustration below may be helpful. General Electric is currently producing a remote control Model 90 kV unit in addition to the composite 70-II and 90-II models. The remote control model allows the operator to have his console mounted out of the room where the tubehead is located.

(Turn to the section on photographs of X-ray units in order to view the various General Electric models manufactured.)


5-313
T0329 B
12-853
T0346 A
55-213
T0226
T0328 B
34-207
55-212
13-1027
37-316
13-925
T0330 B
55-212
66-199
T0330 A
T0330B
26-885
26-296
T0307 A
5-423
26-334
26-297

TUBE HEAD (EXTERIOR PARTS)
AND FORK

CDX DENTAL X-RAY UNIT — MODEL E
Tube Head — Exterior Parts and Fork

MAKE : Philips Oralix

MANUFACTURER: These dental units are manufactured in Holland and merchandised in the United States by:

North American Philips Co., Inc.
Norelco Medical and Dental Division
100 East 42nd Street, New York, New York. 10017

MODELS : There are two kilovoltage ranges on these units; earlier models are 45 kV and more recent ones are 50 kV units.

FILTRATION & COLLIMATION : Oralix dental units come equipped with a rather unique collimating device. On the older units in the 45 kV range, the collimator provides a choice of two aperture sizes. This device is a rectangular metal plate in which are cut two circular apertures. Filters are press-fitted into the apertures. Stamped in the metal collimator beside each aperture is a suggested film size for that particular aperture. This type of collimator slides horizontally into a slit in the pointer cone. By reversing the metal plate, the operator has a choice of the two sizes.

The new 50 kV models have a turret type of collimating device with four apertures in it. By rotating this device, the operator has a choice of four aperture sizes. The field dimensions of the apertures are:

Aperture	Beam Angle	Focus-to-Film Distance	Diameter at Film
#1	24°	4½"	2"
#2	26°	5"	2½"
#3	32°	7"	4"
#4	38°	9"	6"

The inherent filtration on the Oralix Models A and B is 1.0 mm. of aluminum; Models C and D have inherent filtration of 2.0 mm. of aluminum. Filter diaphragms are available from the manufacturer. For Models A and B. No. 93446 will bring the total filtration to 2.0 mm aluminum; No. 93448 will bring the total filtration to 1.5 mm. of aluminum. For Models C and D .5 mm. aluminum discs are available, if additional filtration is desired.

LOCATION OF TUBE NO : Oralix 45 kV units and some early 50 kV units had the tube number placed at the attachment of the handle to the tubehead housing. On some models the tube number is affixed at some position along the bracket arm. More currently manufactured 50 kV models (including the Super 50 kV model) have the number behind the pointer cone on a metal circular ring.

CONSOLE SERIAL NO. : On early models this identifying number was located on a plate at the bottom center of the console control box housing. Later models have the console number on the top surface of the bracket arm.

(Turn to the section on photographs of X-ray units in order to view the various Philips models manufactured.)

MAKE : Ritter

MANUFACTURER: Ritter Company, Inc.
Rochester 3, New York

MODELS : Since 1921, the Ritter Company has manufactured seven different dental X-ray models. Models A, B, D, E, F, G (1 and 2) and H, have the console and tubehead attached, so that these models are one composite unit. The Model G-3 is a remote control model allowing the tubehead to be mounted in one area and the console in another.

FILTRATION & COLLIMATION : Additional filters, in thicknesses of 0.5 mm. aluminum, may be obtained from the factory as follows:

Model A - P-13045, 0.5 mm. aluminum
Models B and D - P-13045, 0.5 mm. aluminum
Models E, F, and G - 3129-6-2, 0.5 mm. aluminum disc retaining ring
(to retain added filters order P-16150 retainer)

Before September 1959, an additional 1.0 mm. aluminum disc was included with each Model E X-ray unit shipped from the factory. After September 1959, an additional 0.5 mm. aluminum disc was included with Models E, F and G.

In order to limit the primary beam to 3 inches at an 8 inch target to film distance on Models B and D, order Z-29 collimator. No such collimator is available for Model A. Models E and F leave the factory with an effective 3 inch beam diameter. Models G and H leave the factory with an effective 2 5/8 inch beam diameter. On Models B and D, a maximum of 2 mm's of the aluminum discs and the Z-29 lead collimator can be assembled into the standard cone without need of a retainer. On Models E, F, and G, one disc can be retained by a snap ring, which is standard on all E, F, and G models.

LOCATION OF TUBE NO. :

Model A	-inside the tube, underneath the filament on the cathode.
Models B and D	-on a plate located on the back of the tubehead housing.
Models E, F, G, and H	-on a plate which is on the underside of the yoke that holds the tubehead.

LOCATION OF CONSOLE NO. :

Model A	-inside the console cabinet so that to view it, one must open the door on the side of the console.
Model B	-on the kV selector dial on top of the console.
Model D	-beside the timer button hanger.
Models E, F, G (1 and 2) and H	-on the bottom surface of the console.
Model G-3	-on lower right side of control console.

GENERAL INFORMATION : For Models B and D with serial numbers lower than 8D-6545, a split-second timer is available from the factory. This timer has a range from 1/8 to 8 seconds. It has a reversible, manual, reset dial available that allows for correction should it ever be over-set. With this timer it is impossible to make an exposure before setting the dial. A period for pre-heating the filament is automatically provided when the timer switch is pressed. With this timer, faster film can be employed, thereby reducing primary radiation to the patient and secondary radiation to the operator. To order this timer, (Part #438-G-18), specify the model and serial number of the unit. *It is not available for models other than B and D.*

(Turn to the section on photographs of X-ray units in order to view the various Ritter models manufactured.)

MAKE : Siemens

MANUFACTURER: Siemens, Reiniger Werke, A. G.; Erlangen, Germany. Marketed in the United States by:

Siemens America, Inc.
Dental Division
10-39 44th Drive
Long Island City 1, New York

MODELS : Essentially, there are only two Siemens dental X-ray models. One is referred to as the Heliodent; the other as the Heliosphere.

The Heliodent unit is a 50 kV, 7 mA unit. These models can be attached to several different makes of dental operating units, so that the Heliodent model has varying designs, depending on how the unit is to be attached. The units are designed to be mounted in the following ways:

1. Unit mounted for Sirona C, D, F, and G units.
2. Unit mounted for S. S. White, Master, and Selector units.
3. Unit mounted for Ritter, Weber, and other units.
4. Wall mounted with board.
5. Mobile unit.

The Heliosphere 2" Model operates in the 60-72 kV range. Its mA capabilities are 10-12 mA. It was engineered for 220 volt, 50 cycle a.c. power supply. To our knowledge it is not marketed in the United States. It is manufactured in two designs:

1. Mobile mounted unit.
2. Wall mounted unit.

FILTRATION & COLLIMATION : Heliodent units currently being manufactured have an inherent filtration of 2 mm. of Al. The manufacturer makes the following statement with regard to collimation:

> "The radiation beam is confined by a diaphragm at the tip of the cone to a diameter of 5.8 cm (2-5/16"), conforming to State and Federal requirements."

LOCATION OF TUBE NO. : The tubehead serial numbers on Heliodent units can be located on a metal ring behind the pointer cone.

LOCATION OF CONSOLE NO. : The console serial number is located on the top surface of the bracket arm on the wall mounted units. The mobile unit has this number near the base of the main column.

(Turn to the section on photographs of X-ray units in order to view the various Siemens models manufactured.)

MAKE : Weber

MANUFACTURER: Weber Dental Manufacturing Company
2206 Thirteenth Street N.E.
Canton 5, Ohio

MODELS : The Weber Dental Manufacturing Company has manufactured some 31 different dental X-ray models, beginning with the #1 series and progressing through the new Ultron 90 kV unit.

FILTRATION & COLLIMATION : Currently all dental X-ray units, whether 70 kV or 90 kV, are equipped with 2.5 mm. of total filtration and the following statement is enclosed with each unit shipped from the factory:

> "To comply with requirements of many States, this Weber Oil Immersed X-ray Head has a total filtration (inherent plus added) equal to 2.5 mm. of aluminum permanently installed. With the addition of the cone pointer, this X-ray Head has a total minimum filtration of 3.0 mm. of aluminum. Also installed in this Head is a lead washer that limits the beam to 3" at an 8" focal point. All requirements of ADA, Bureau of Standards Handbook 60, various State agencies and all presently known agencies, have been incorporated in this Weber Oil Immersed X-ray Tube Head."

Older models may require additional filtration. The following collimator and filter kits may be obtained from the factory:

XR-8818 G - three aluminum filters of 0.5 mm. thickness each.
XR-8077 - one lead washer.
XR-8137 - one snap ring for holding these discs in place.

LOCATION OF TUBE NO. : Tube serial numbers are located on a metal ring behind the pointer cone. (On some models it may be necessary to remove the metal plate on the tubehead housing in order to see the number.) The tube number of the new #90 series is on the outside of the tubehead housing; on the old #4 models, it is inside the tube under the filament on the cathode.

LOCATION OF CONSOLE NO. : Console serial number plates are not consistent as to location. They are usually located on the back of the console. (Some consoles open and it is necessary to open the door in order to see the serial plate.) The three models in the #5 series have the number affixed to the tubehead bracket arm where it attaches to the console; the models in the #6 series have it on the front of the console control box housing; and on the new models, it is on the back of the console.

GENERAL INFORMATION :	Weber Dental Manufacturing Company produced X-ray units in Models #1, #2, and #3, which most likely will never be seen during a survey due to their early vintage. It is difficult to state, with accuracy, the focal spot end-of-pointer-cone distance on the various models. Since the National Bureau of Standards recommendation of 7 inch target-skin distance in Handbook 76 was made, the Weber Dental Manufacturing Company has made a Bakelite spacer which enables their X-ray units to have a 7 inch target-skin distance. This spacer was not used on early models, therefore, may not be found on some units. If it is *not* found, the target-skin distance is 6.25 inches. The spacer may be obtained from the factory for old Weber units and is listed as Part Number X-R-1843, "ring nut". (Turn to the section on photographs of X-ray units in order to view the various Weber models manufactured.)

MAKE : XRM

XRM is an abbreviation for X-ray Manufacturing Corporation of America.

MANUFACTURER: The S. S. White Company purchased the X-ray Manufacturing Corporation on March 28, 1958. Dental X-ray units manufactured for S. S. White Company bear the trade name XRM.

X-ray Manufacturing Corporation of America
Community Drive
Great Neck, New York 11021

MODELS : XRM has produced some 15 different dental X-ray models, including panoramic, cephalometric, and split models. Models 2A, 3A, 1B, 2B, and 3B were produced from approximately the year 1939 to 1957. Models 2B and 3B were 60 kV, 15 mA units; 2A, 3A, and 1B were 70 kV, 15 mA units. Since 1957 XRM has produced composite models 70S, 70P, 90S, and 90P; split models 70W and 90W; cephalometric models OR90S and OR90P; and the panoramic unit which is called "Panorex". XRM manufactured a 70 kV cephalometric X-ray unit before 1956.

FILTRATION & COLLIMATION : When many of the earlier XRM models were produced, no recommendations were existant concerning filtration and collimation. For that reason, XRM produced its early models with a 0.75 mm. equivalent filtration. Subsequent to the National Bureau of Standards recommendations in 1955, XRM wrote a letter to the customers listed in their files, stating that an additional 1.25 mm. of Al filter was available. As a result, many thousands of filters were supplied to XRM customers. As an aid to the identification of specific amounts of filtrations, the following statements may be noteworthy:

> *If,* upon removal of the pointer cone, *a concave piece of aluminum is observed to be permanently mounted behind the brass ring, that unit has only 0.75 mm.* Al equivalent inherent filtration.
>
> *If the unit has 1.25 mm. of loose aluminum filter in front of the brass ring, then it has been modified* to the correct amount of filtration as advocated by the National Bureau of Standards.

During repairs to any older tubeheads sent back to the XRM factory, 2.5 mm. Al was installed permanently behind the brass ring. These units can be differentiated from the 0.75 mm. equivalent units by the fact that *when the factory installed the 2.5 mm. equivalent, they used a flat, rather than a concave, filter behind the brass ring.* Since 1956, every tubehead shipped from the factory was shipped with 2.5 mm. inherent filtration permanently installed.

With regard to collimation, XRM units formerly had a 5.5" target-skin distance when the standard short pointer cone was utilized. The beam diameter with the earlier units was within 3" when the original pointer cone was used. This gives a target-tip-of-cone distance of 5.5". Currently, XRM is producing a pointer cone which produces a target-tip-of-cone distance of 7". This was begun as a result of the NBS recommendation that the target-skin distance must be 7" for units operating at 50 kV or above. The 7" pointer cone is provided with a collimator which has an aperture diameter of 3/4". A long cone is also available which will provide an effective beam diameter at the skin which is within 3". The long cone aperture has an inside measured diameter of 7/16". The cones just described can be obtained from the factory without a specified part number. However, size of the aperture diameter must be specified, and preference must be stated for either long or short cone.

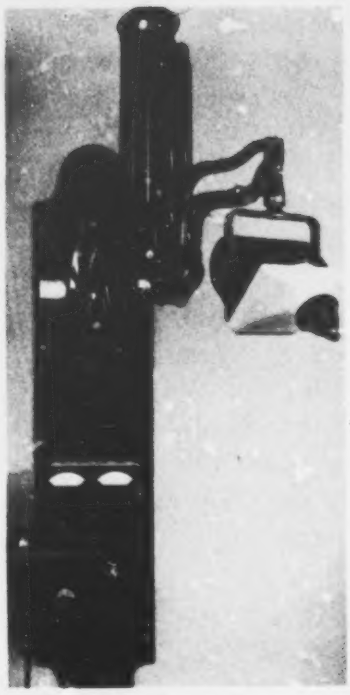
LOCATION OF TUBE NO. : XRM has maintained a consistent position for placing tubehead serial numbers. They can be found stamped into the brass ring behind the pointer cone. Two numbers are present on the brass ring; the shorter one, or the number with an alphabetical letter in it, is the tube number; the other is the transformer number.

LOCATION OF CONSOLE NO. : Console numbers are usually on the right side of the console, by the "off-on" switch. However, there are units which bear this number plate on the left side.

GENERAL INFORMATION : In 1956 the first 90 kV unit was produced. A 70 kV unit was available in the same console. These units came equipped with the first split-second timers manufactured by XRM. The 90 kV unit's timer was a 1/30 second impulse timer. The 70 kv unit's timer was a synchronous, automatic reset timer calibrated from 1/4 second to seven seconds. In 1959 XRM produced their first split model design. They currently market several split model console designs. Up to five tubeheads can be operated from one console on the split models.

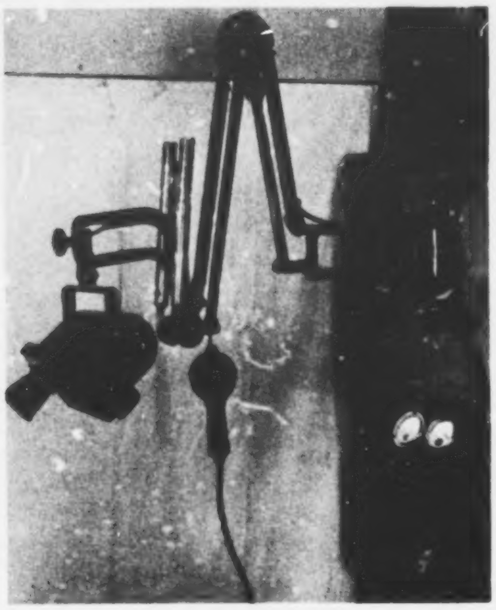
(Turn to the section on photographs of X-ray units in order to view the various XRM models.)

GENERAL ELECTRIC DENTAL X-RAY EQUIPMENT



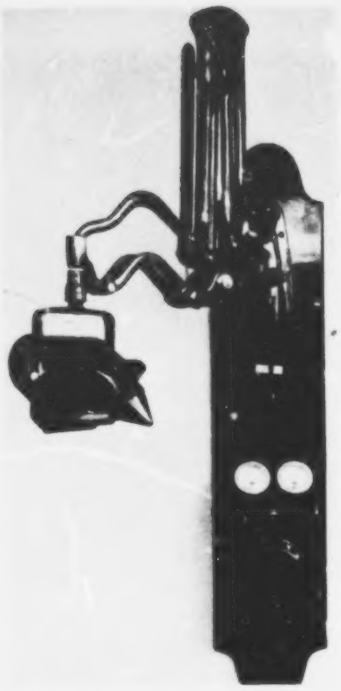
GE CDX-E
Wall Model

KV - 65
MA - 10
FSD - 8"



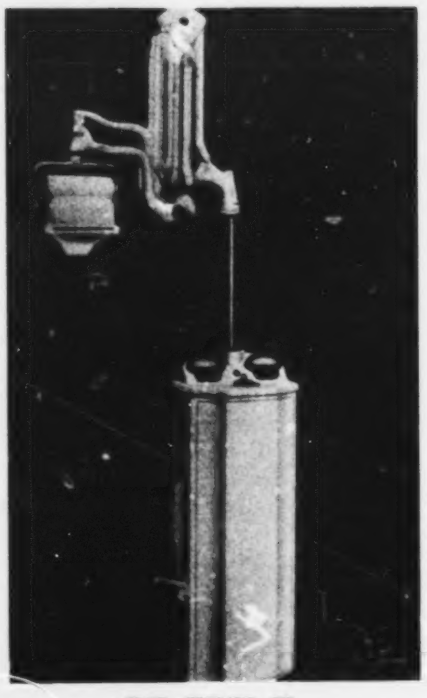
VICTOR CDX

KV - 53
MA - 10
FSD - 8"



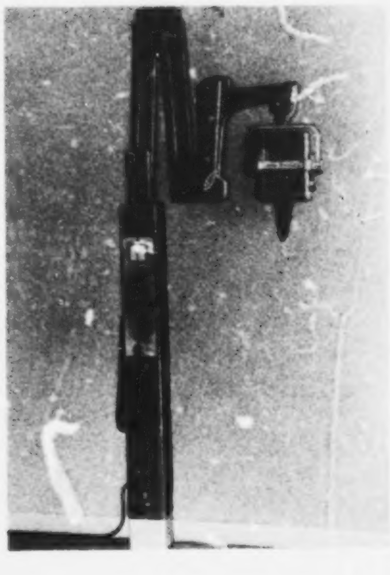
GE CDX-E
Wall Model

KV - 65
MA - 10
FSD - 8"



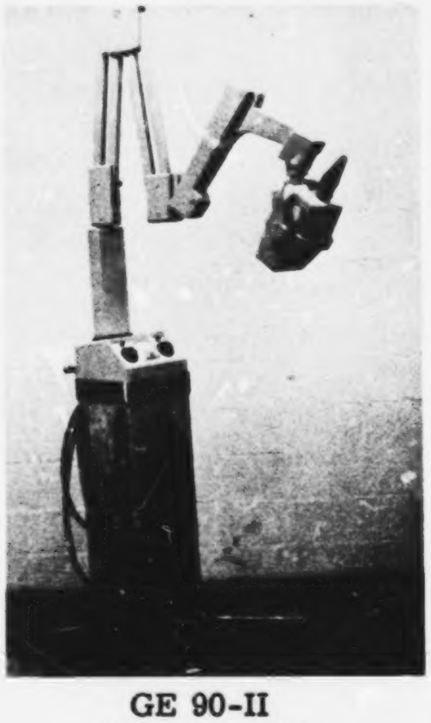
GE CDX-E
Floor Model

KV - 65
MA - 10
FSD - 8"



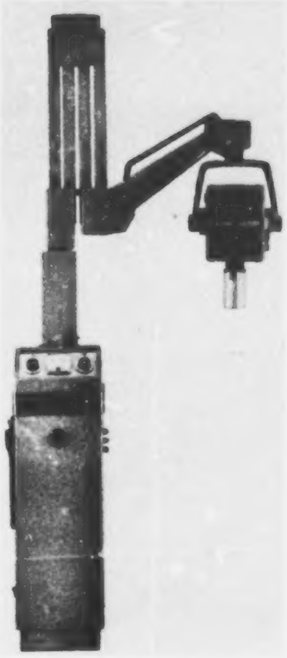
GE 70-II
Slimline Model

KV - 70
MA - 10
FSD - 8"



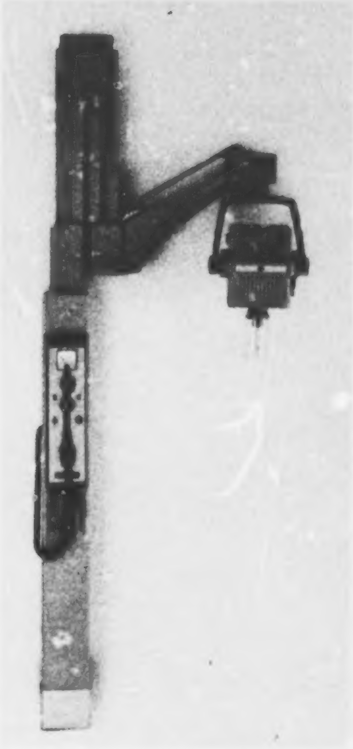
GE 90-II
Mobile Model

KV - 90
MA - 15
FSD - 8"



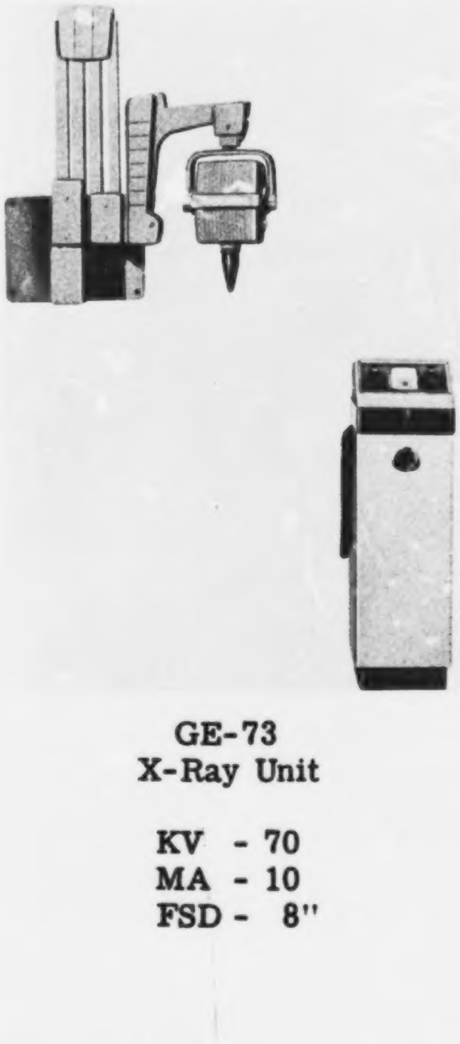
GE-100
Stationary X-Ray
Unit

KV - 100
MA - 15
FSD - 8"



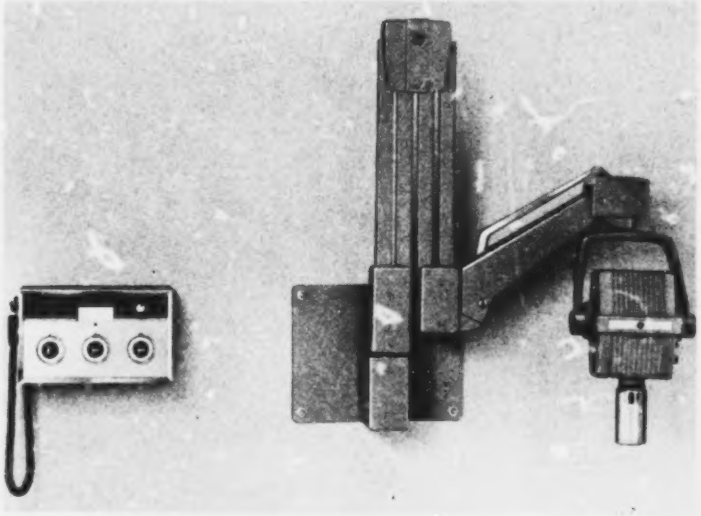
GE 90-II
Remote Control Console
and Tubhead

KV - 90
MA - 15
FSD - 8"



GE-73
X-Ray Unit

KV - 70
MA - 10
FSD - 8"

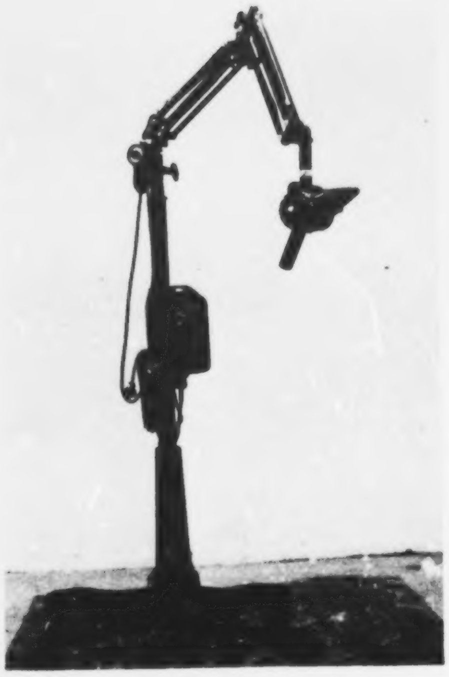


GE-100
Remote Control X-Ray Unit with compact
control and wall support for tubehead.

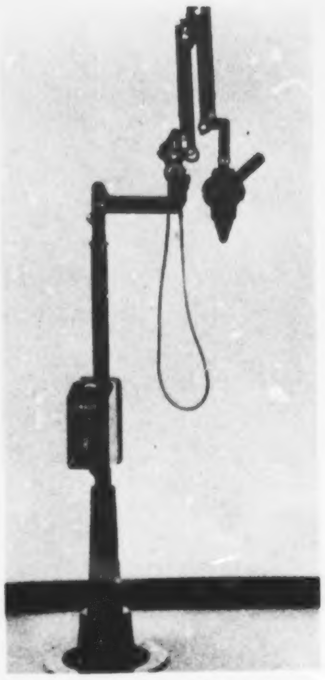
KV - 100
MA - 15
FSD - 8"

PHILIPS ORALIX DENTAL X-RAY EQUIPMENT

45 Series



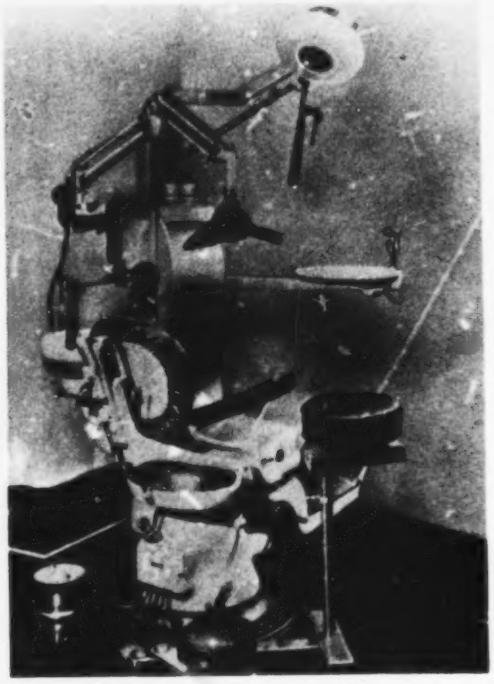
MOBILE TYPE
KV - 45
MA - 5
FSD - 4"



FLOOR MOUNTED
KV - 45
MA - 5
FSD - 4"

CUSPIDOR MOUNTED

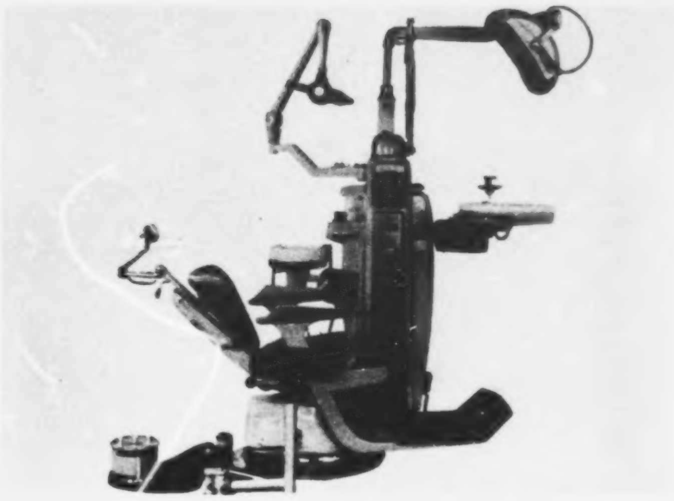
KV - 45
MA - 5
FSD - 4"



UNIT MOUNTED

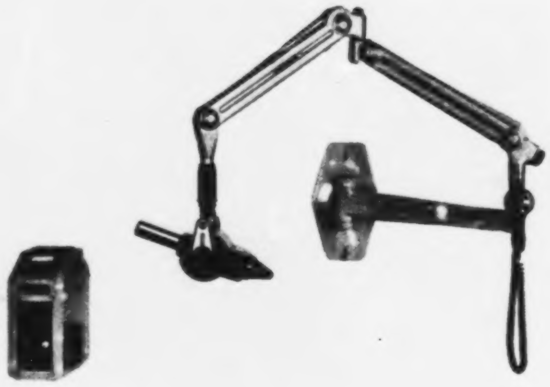
KV - 45
MA - 5
FSD - 4"

Philips Oralix
Super 50 Series



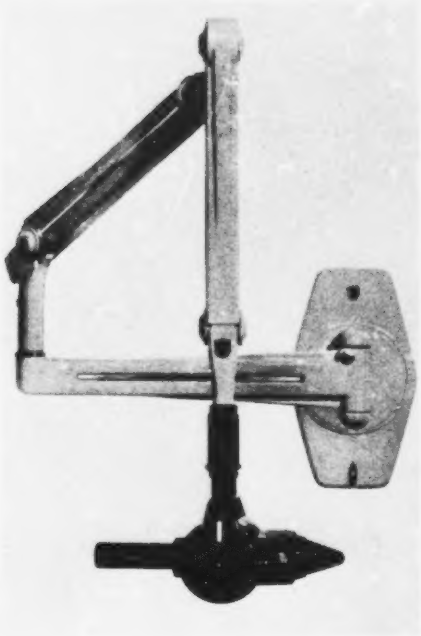
UNIT MOUNTED

KV - 50
MA - 7
FSD - 4"



SPLIT MODEL

KV - 50
MA - 7
FSD - 4"

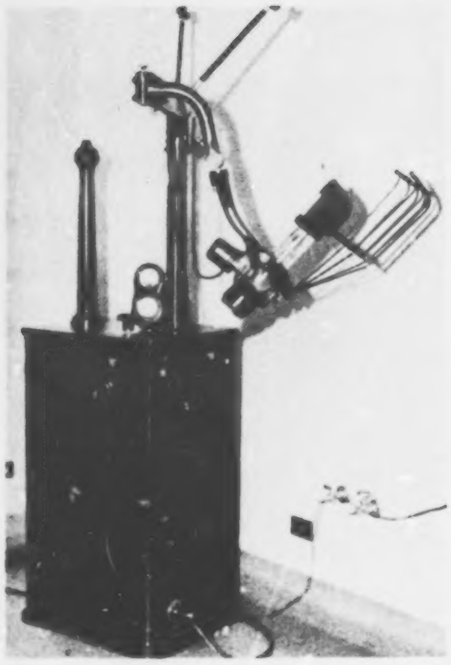


COMPOSITE MODEL

KV - 50
MA - 7
FSD - 4"

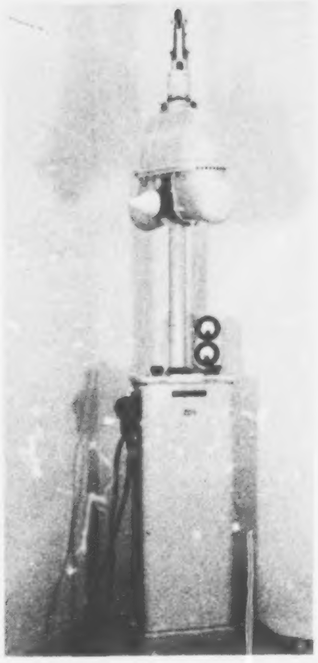
The controls are on
the bracket arm

RITTER DENTAL X-RAY EQUIPMENT



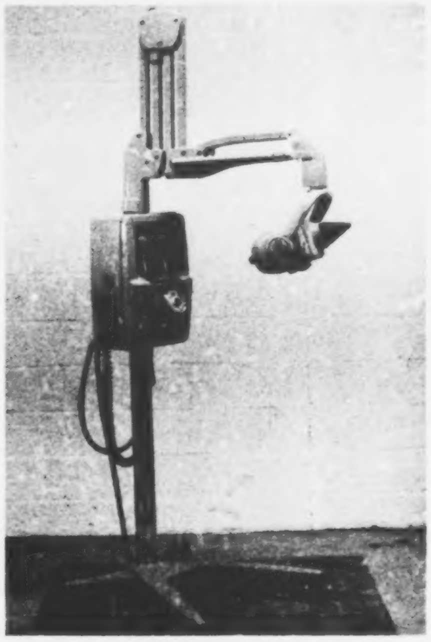
RITTER A
Mobile Model
KV - 63
MA - 10
FSD - 7"

RITTER B
Mobile Model
KV - 65
MA - 10
FSD - 7"

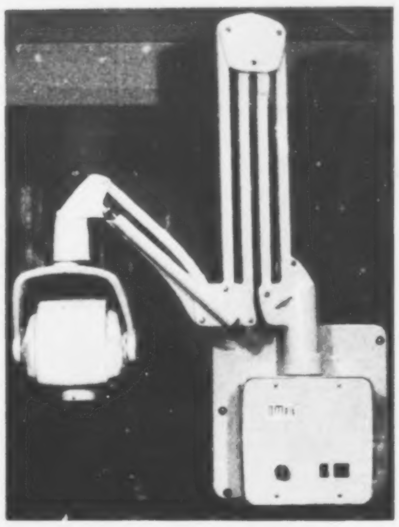


RITTER D
Mobile Model
KV - 70
MA - 15
FSD - 7"

RITTER E
Floor Model
KV - 90
MA - 15
FSD - 7"

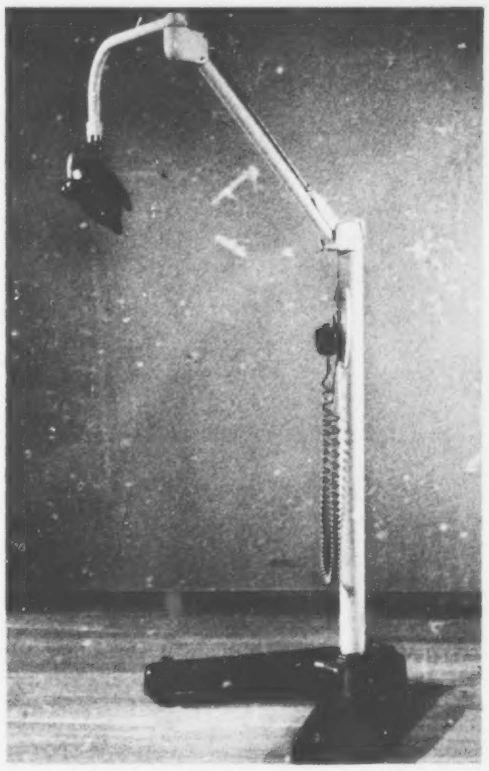


RITTER F
Mobile Model
KV - 90
MA - 15
FSD - 7"



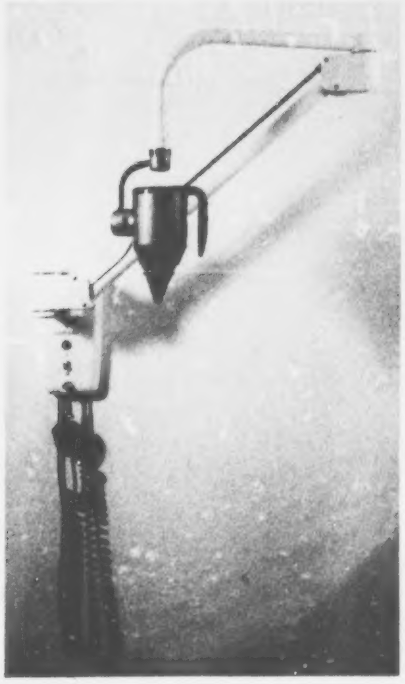
Model H
KV - 75
MA - 15
FSD - 7"

SIEMENS DENTAL X-RAY EQUIPMENT

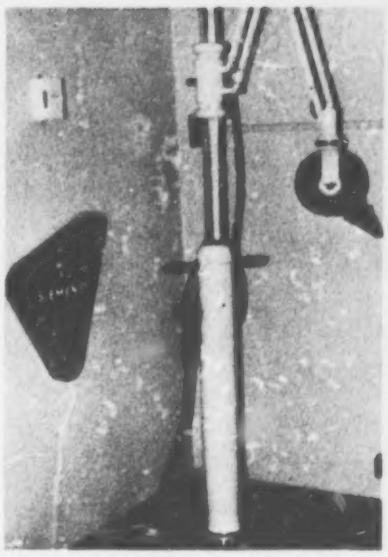


SIEMENS Heliodent
Mobile Unit

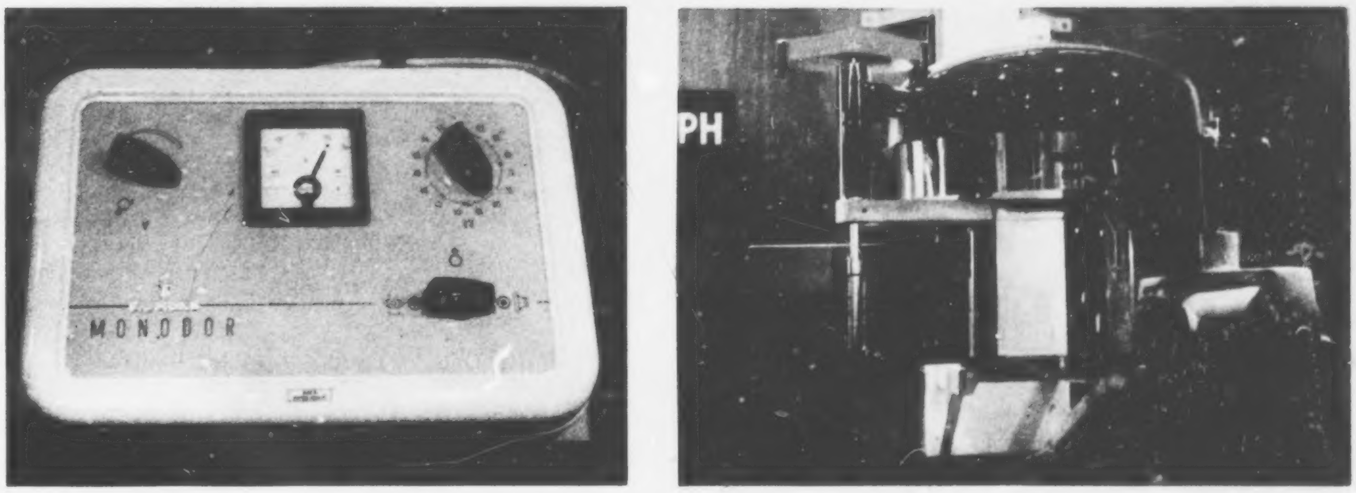
KV - 50
MA - 7
FSD - 4"



SIEMENS Heliodent
Wall Mounted Unit
KV - 50
MA - 7
FSD - 4"



SIEMENS Heliosphere
Floor Mounted Unit
KV - 72
MA - 12
FSD - 4"

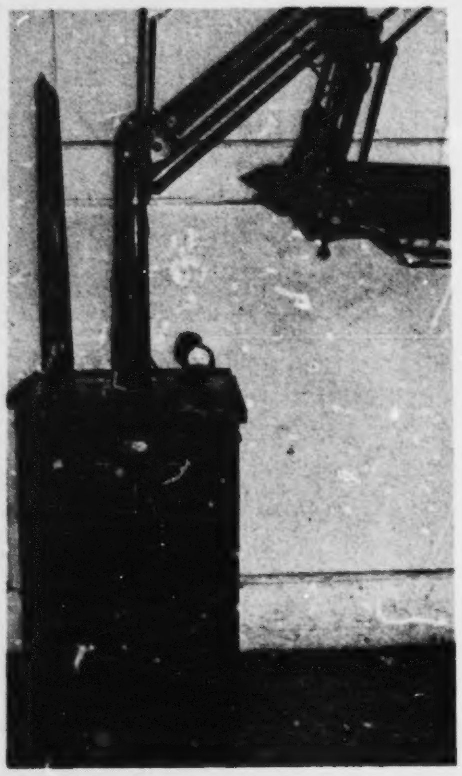


SIEMENS ORTHOPANTOMOGRAPH

Console

Tubehead and Head Positioning Device
with Cassette

WEBER DENTAL X-RAY EQUIPMENT

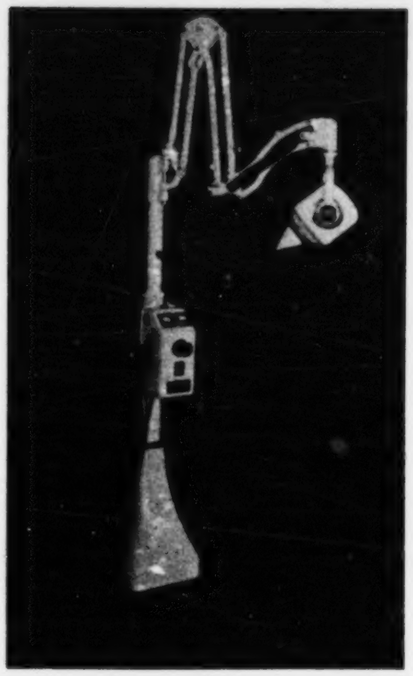


WEBER 4
Mobile Unit
KV - 65
MA - 10
FSD - ?

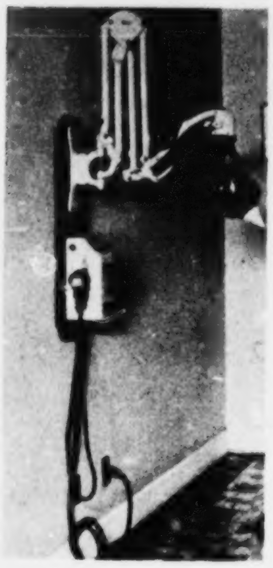
WEBER 5
Navy Unit
KV - 65
MA - 10
FSD - 6.25"

WEBER 5
Floor Unit
KV - 65
MA - 10
FSD - 6.25"

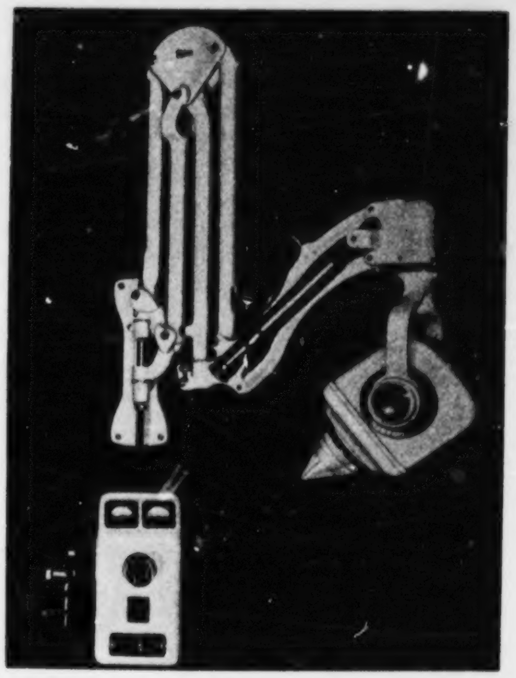
WEBER 5
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"



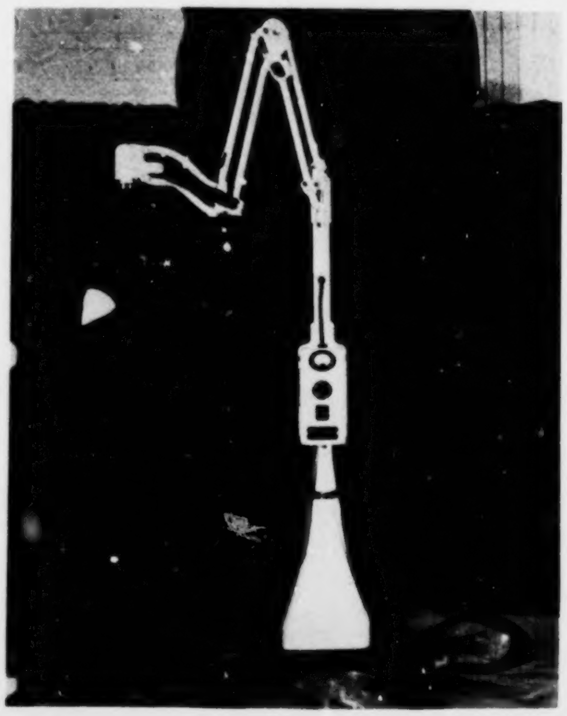
WEBER 6
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"



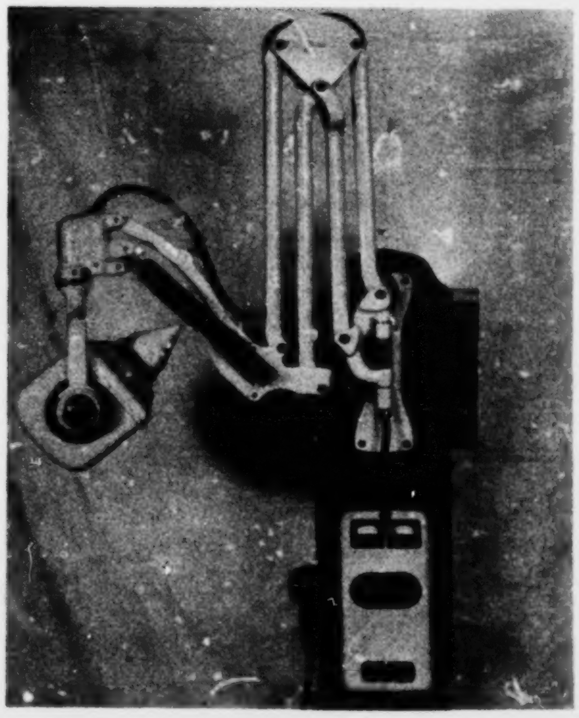
WEBER 6
Wall Unit
KV - 65
MA - 10
FSD - 6.25"



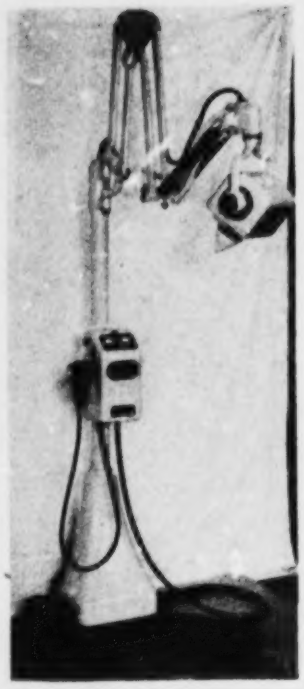
WEBER 6
Wall Unit
KV - 65
MA - 10
FSD - 6.25"



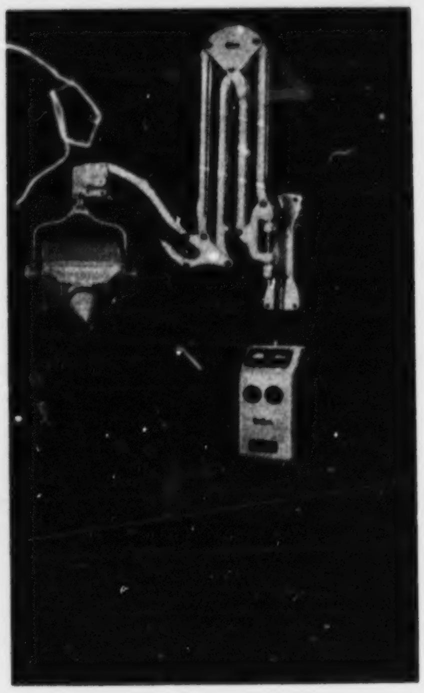
WEBER 6
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"



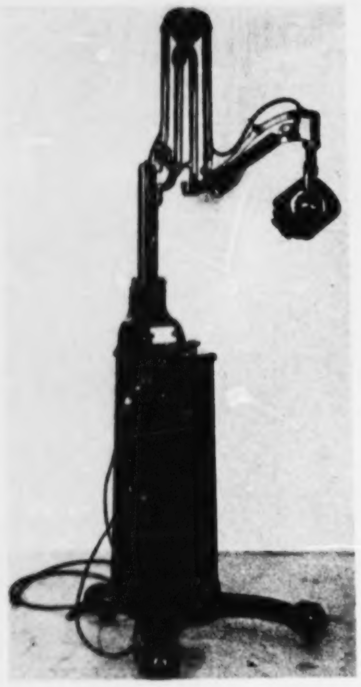
WEBER 6A
Wall Unit
KV - 65
MA - 10
FSD - 6.25"



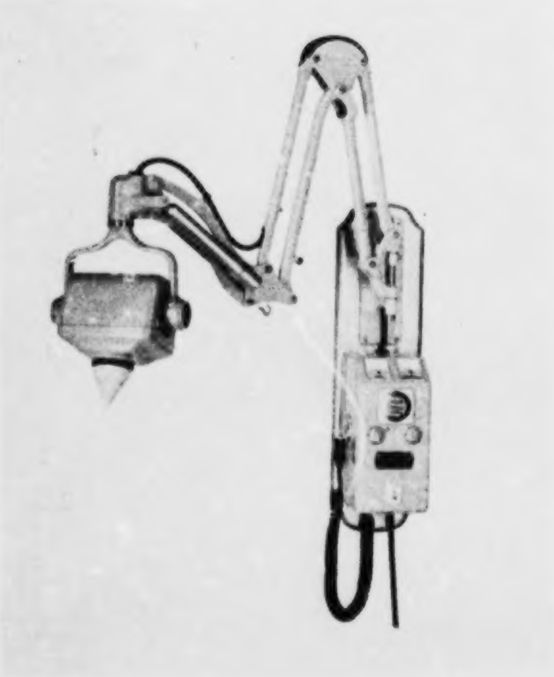
WEBER 6A
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"



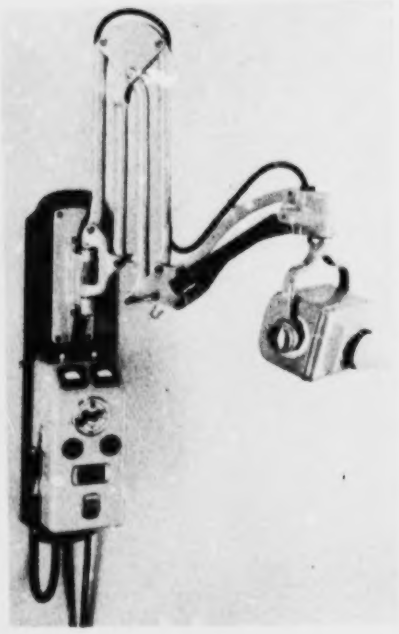
WEBER 6B
Wall Unit
KV - 65
MA - 10
FSD - 6.25"



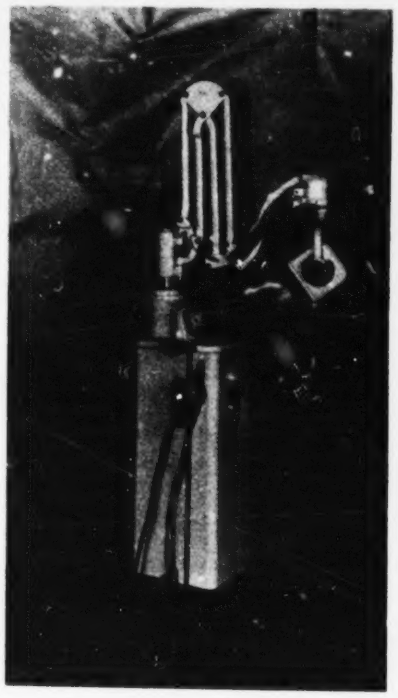
WEBER 7
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"



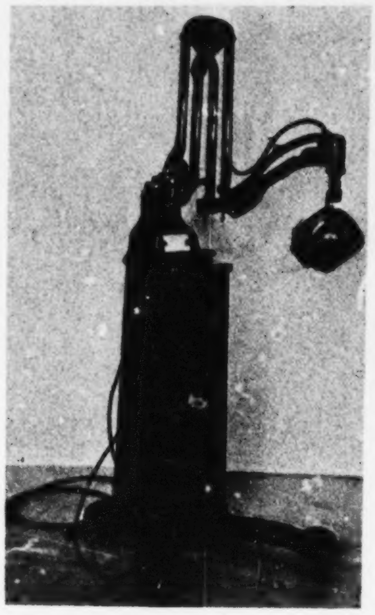
WEBER 6R
Wall Unit
KV - 70
MA - 15
FSD - 7"



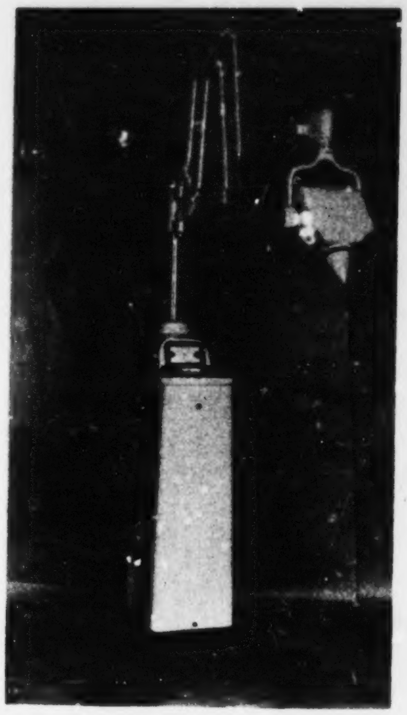
WEBER 6R
Wall Unit
KV - 70
MA - 15
FSD - 7"



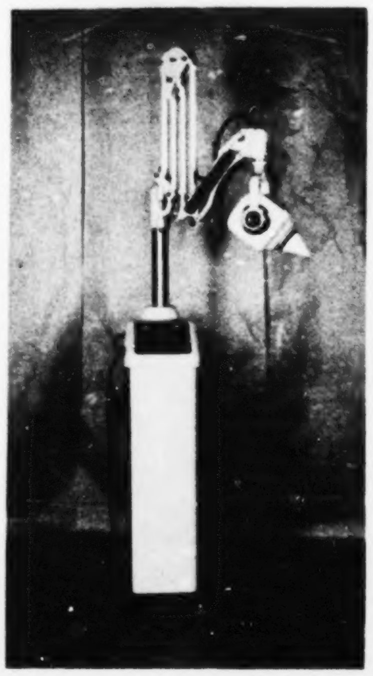
WEBER 7
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"



WEBER 7
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"

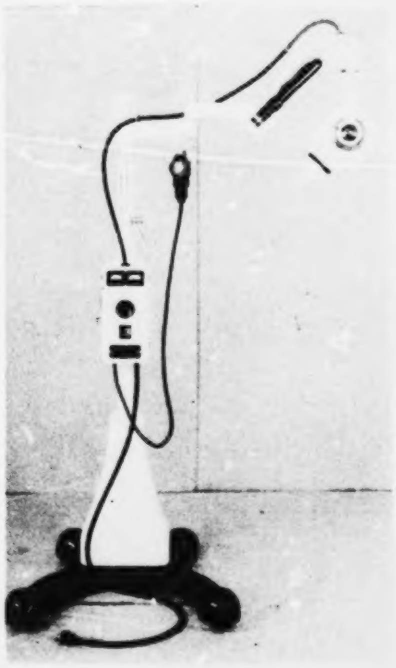


WEBER 7
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"

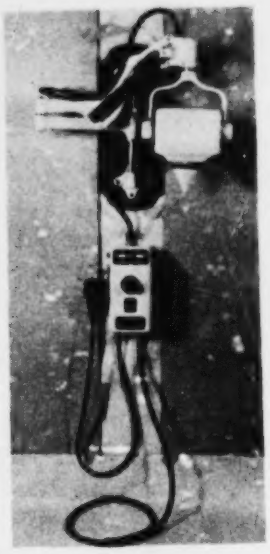


WEBER 7A
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"

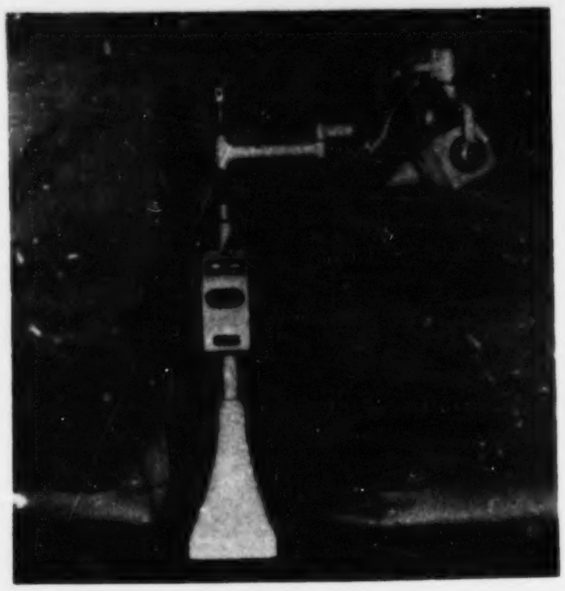
WEBER 7A
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"



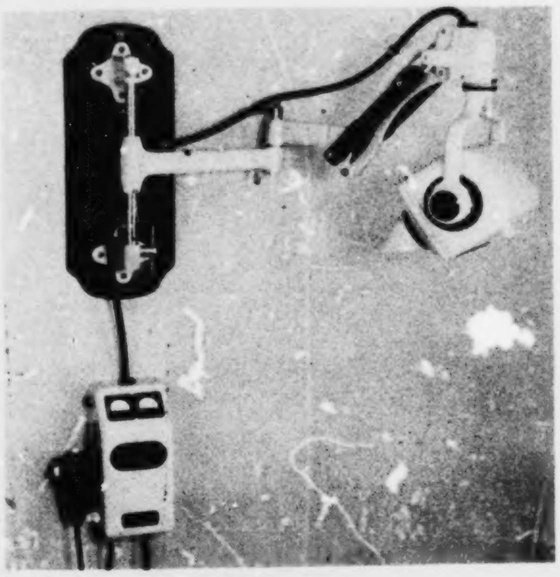
WEBER 9
Mobile Unit
KV - 65
MA - 10
FSD - 6.25"



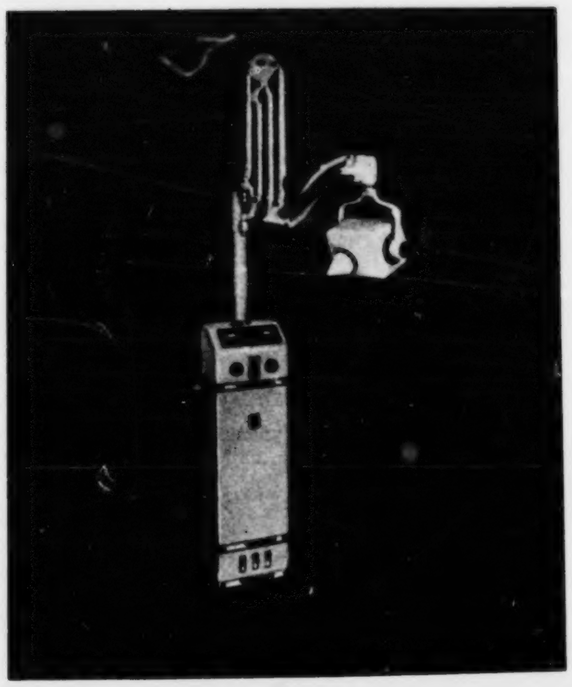
WEBER 9
Wall Unit
KV - 65
MA - 10
FSD - 6.25"



WEBER 9A
Floor Unit
KV - 65
MA - 10
FSD - 6.25"

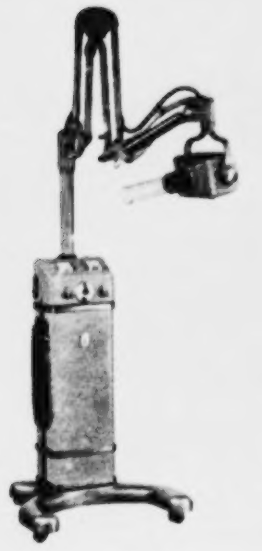


WEBER 9A
Wall Unit
KV - 65
MA - 10
FSD - 6.25"



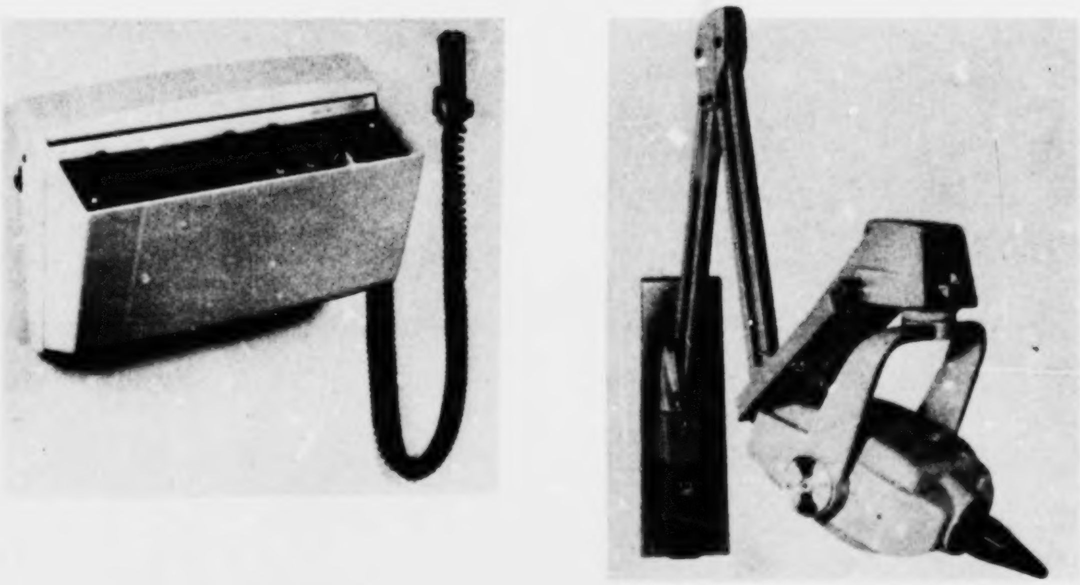
WEBER 11
Floor Unit
KV - 70
MA - 15
FSD - 7"

WEBER 11R
Floor Unit
KV - 70
MA - 15
FSD - 7"



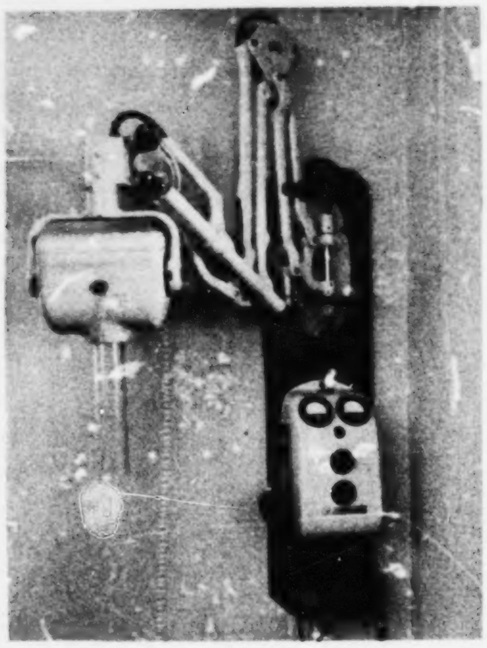
WEBER 11R
Mobile Unit
KV - 70
MA - 15
FSD - 7"

WEBER 12R
Floor Unit
KV - 90
MA - 15
FSD - 7"

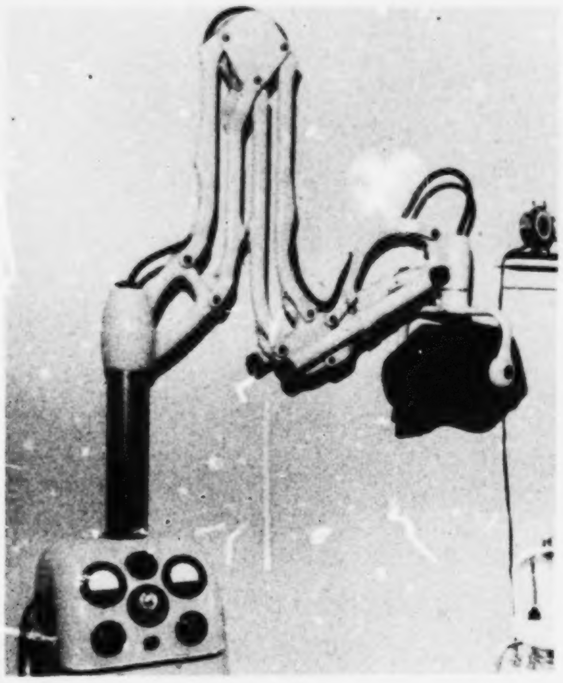


WEBER Ultron Split Model Console & Tubehead
KV - 90
MA - 15
FSD - 7"

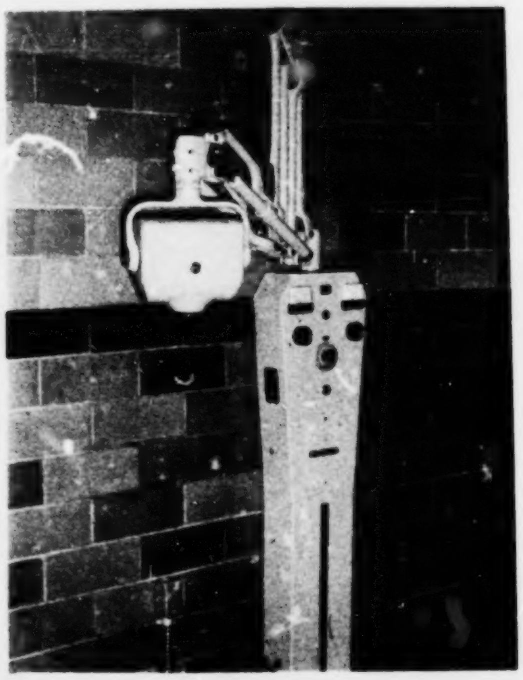
XRM DENTAL X-RAY EQUIPMENT



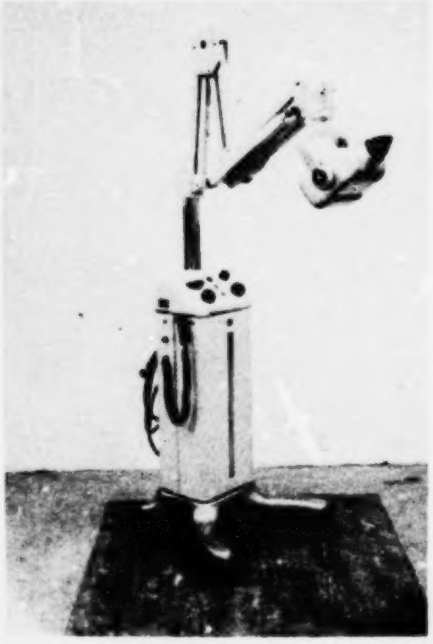
XRM 2B
Wall Model
KV - 60
MA - 15
FSD - 5.5"



XRM 3A
Floor Model
KV - 70
MA - 15
FSD - 5.5"



XRM 90P
Space Maker
KV - 90
MA - 15
FSD - 7"

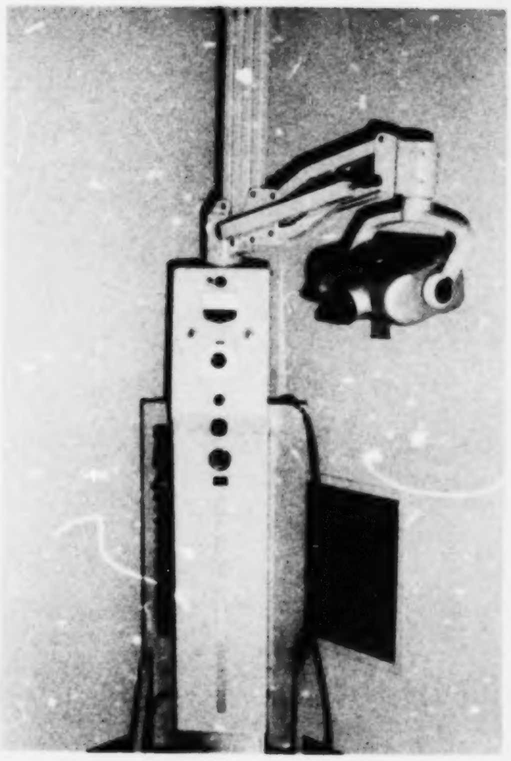


XRM 90S
Mobile Model
KV - 90
MA - 15
FSD - 7"

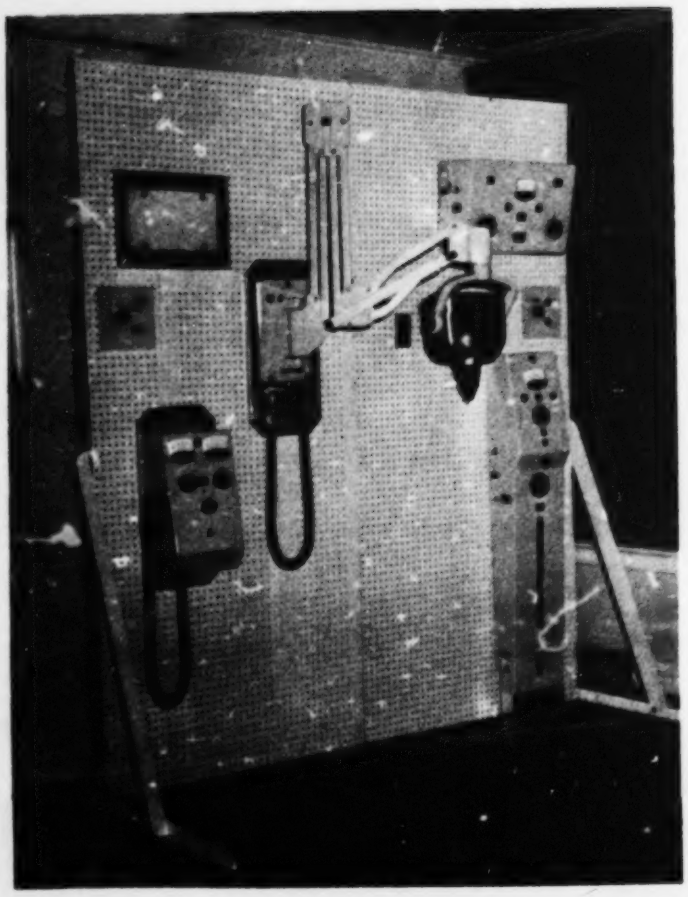
Early XRM 90 kV console with one of the first split-second timers, seen here mounted on column.

KV - 90
MA - 15
FSD - 5.5"

XRM PANOREX
KV - 90
MA - 10
FSD - ?



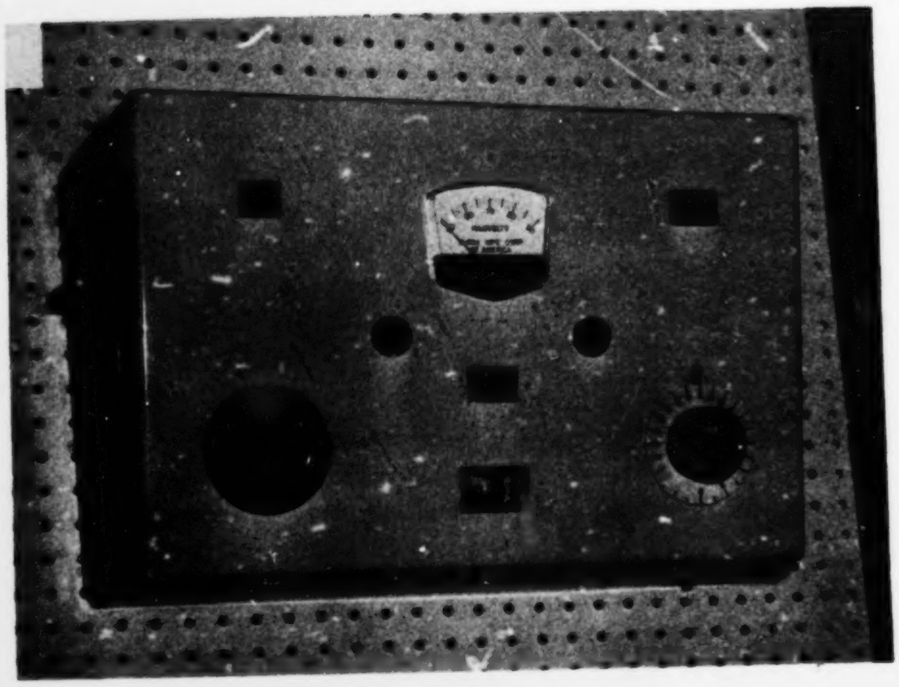
XRM SPACEMAKER
Composite Unit
KV - 90
MA - 15
FSD - 7"



XRM

1964 Split Model Consoles with Tubehead

KV - 90
MA - 15
FSD - 7"



Close-up of one of the XRM 90 kV consoles

SELDOM ENCOUNTERED DENTAL X-RAY UNITS

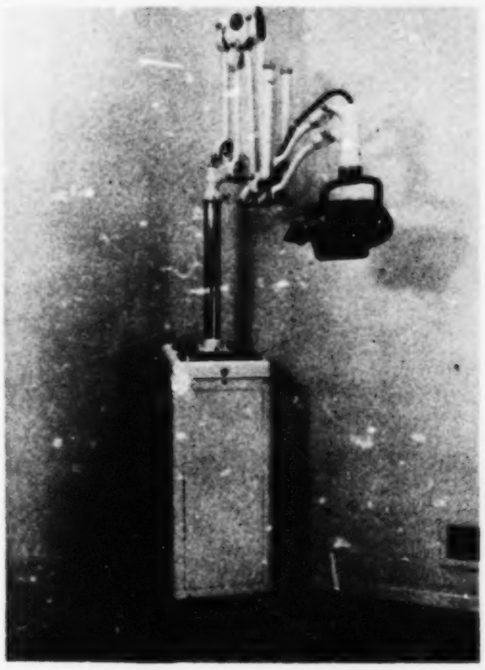
MAKE : Fischer

Discontinued manufacturing dental X-ray equipment in 1952. Continues to manufacture X-ray generators for other purposes.

MANUFACTURER: H. G. Fischer
9451 W. Belmont Avenue
Franklin Park, Illinois

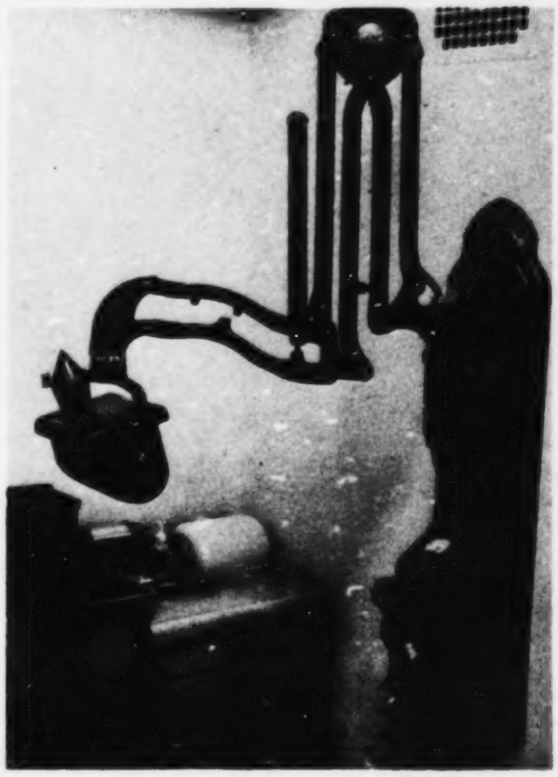
LOCATION OF TUBE NO. : On a plate directly under the pointer cone.

LOCATION OF CONSOLE NO. : On the right side, on a plate beneath the opening through which the electric cord passes.



FISCHER-CMDX
Mobile Unit

KV - 65
MA - 10
FSD - ?



FISCHER-DX
Wall Mounted

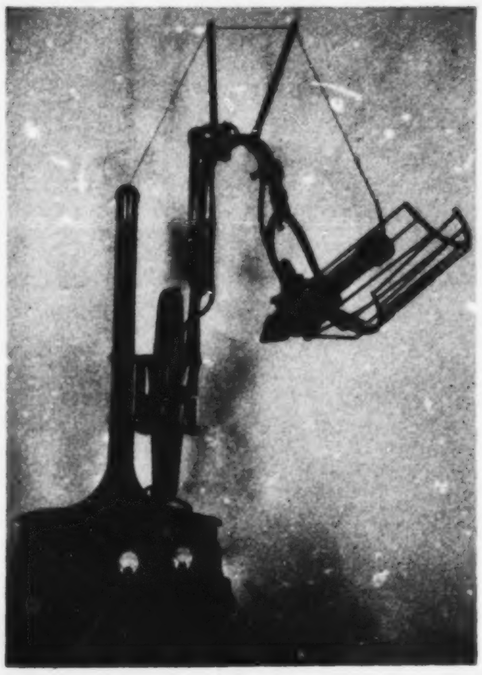
KV - 65
MA - 10
FSD - ?

MAKE : International

MANUFACTURER: Union Dental Instrument Manufacturing Company
Philadelphia, Pennsylvania

LOCATION OF TUBE NO. : Inside the tube beneath the filament on the cathode.

LOCATION OF CONSOLE NO. : On a metal plate on the back of the console.



Mobile Mounted

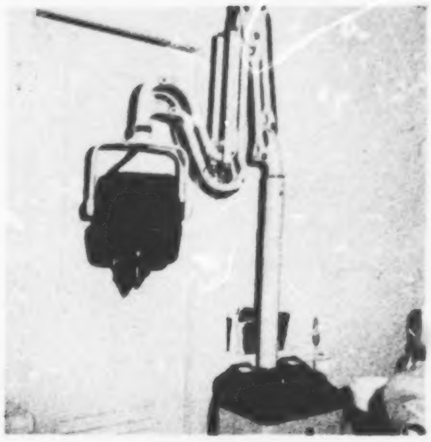
KV - 65
MA - 10
FSD - ?

MAKE : Wm. Meyer

MANUFACTURER: Wm. Meyer Corporation
Chicago, Illinois

LOCATION OF TUBE NO. : Unknown

LOCATION OF CONSOLE NO. : On back of console.



Floor Mounted

KV - 90
MA - 15
FSD - ?

Note: This unit can be properly collimated and filtered by adding the PHS (Dental) Fischer Collimator and 1.0 mm. of aluminum.

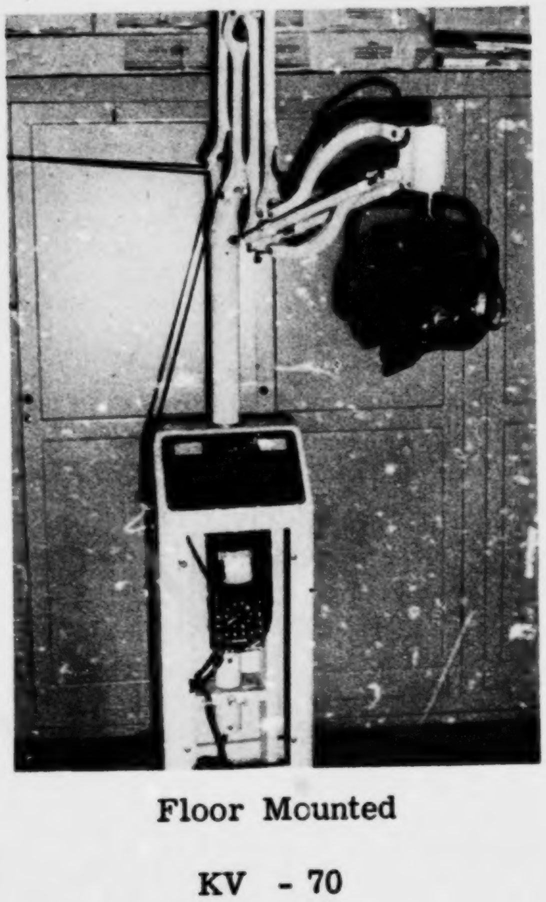
MAKE : Picker

Picker X-ray Corporation has discontinued manufacturing *dental* X-ray equipment.

MANUFACTURER: Picker X-ray Corporation
Waite Manufacturing Division, Inc.
Cleveland, Ohio

LOCATION OF TUBE NO. : On side of the tubehead housing at yoke connection.

LOCATION OF CONSOLE NO. : By the "off-on" switch on the right side of console.



Floor Mounted

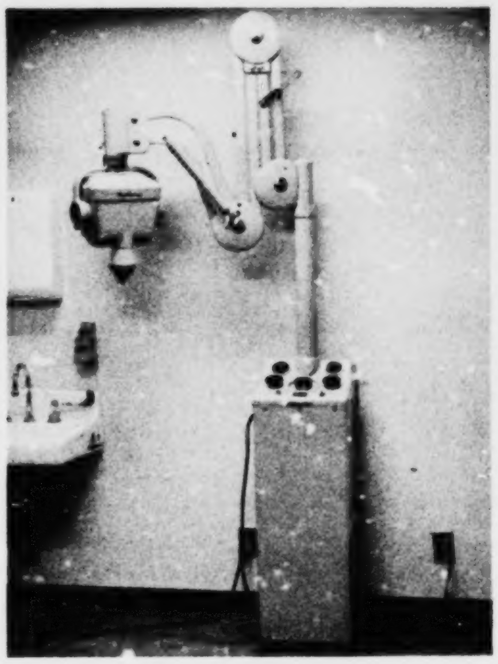
KV - 70
MA - 10
FSD - ?

MAKE : Profexray

MANUFACTURER: Profexray Inc.
Maywood, Illinois

LOCATION OF TUBE NO. : On a plate located outside on the tubehead housing.

LOCATION OF CONSOLE NO. : On the back of the console.



Wall Mount

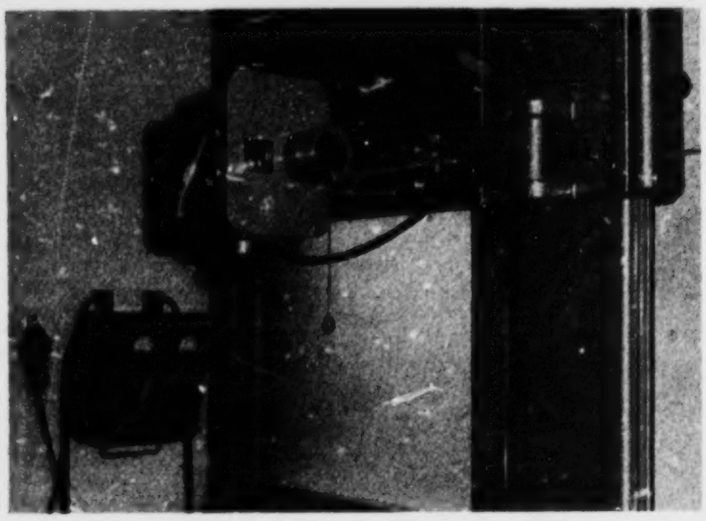
KV - ?
(voltmeter 30-150 v.)
MA - 5-20

MAKE : Universal (Cephalometric Unit)

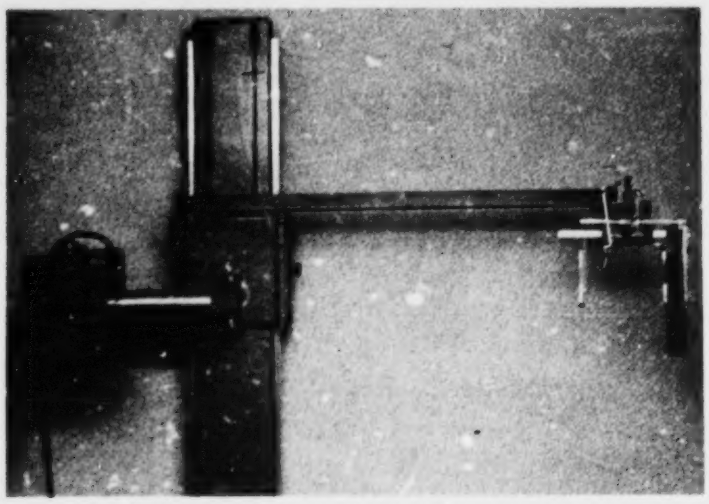
MANUFACTURER: Universal X-ray Products Inc.
1138 North Western Avenue
Chicago, Illinois

LOCATION OF TUBE NO. : On the front of the tubehead housing.

LOCATION OF CONSOLE NO. : Unknown



Timer, Control Box, and Tubehead



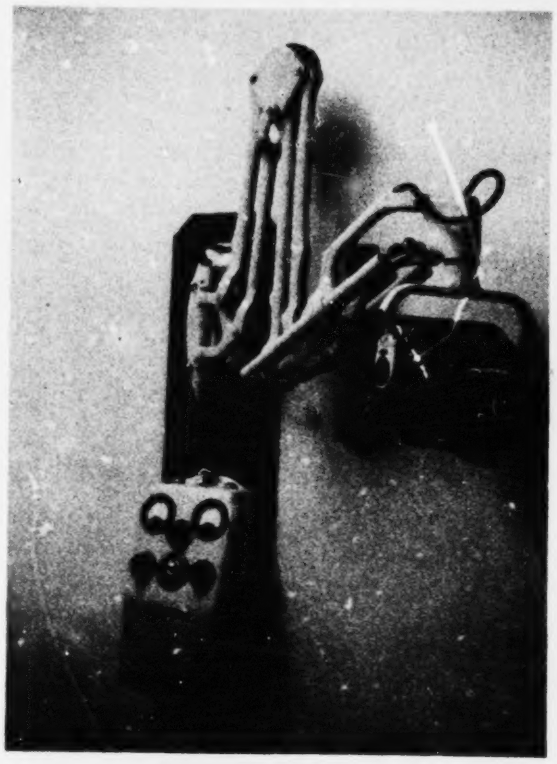
Tubehead and Head Positioning Device

MAKE : Westinghouse

MANUFACTURER: Westinghouse Electric Corporation
2521 Wilkens Avenue
Baltimore, Maryland

LOCATION OF TUBE NO. : On the brass ring behind the pointer cone.

LOCATION OF CONSOLE NO. : On left side of console housing.



Wall Mounted

KV - 60 - 65
MA - 10
FSD - 5.5"

WESTINGHOUSE PANORAMIX

Tube

Normal 70 KV at 1 MA
for one second

Control

30 - 70 KV
0 - 1 MAS

SUPPLIERS OF ELECTRONIC TIMERS

Electronic Control Corp.
1573 E. Forest Ave.
Detroit 7, Mich.

X-ray Manufacturing Corp. of America
Lake Success Park, Community Dr.
Great Neck, N. Y.

Hanau Engineering Co., Inc.
1233 Main St.
Buffalo 9, N. Y.

Liebel Flarsheim Co.
111 E. Amity Rd.
Cincinnati 15, Ohio

SUPPLIERS OF LONG OPEN END TUBES (CONES)

R. Margraf, Fab.
27 Woodhill Drive
Willow Grove, Penn.

General Electric Company
4855 Electric Avenue
Milwaukee, Wisconsin 53201

Ritter Equipment Company
P.O. Box 848
Rochester 3, New York

Weber Dental Manufacturing
Company
2206 13th Street, N.E.
Canton, Ohio 44705

X-Ray Manufacturing Corporation
of America
Community Drive
Great Neck, New York

General Information

Illustrations

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GENERAL INFORMATION ABOUT AVAILABLE DENTAL X-RAY FILMS

DUPONT	E. I. DuPont de Nemours and Company make two speeds of film--DuPont *D* and Lightning Fast. Code number on the *D* film includes the letter *D*. A bitewing film is produced which is indicated by the code letters *BW*. The Lightning Fast code numbers include the letters *LF*.
IFI	International Film Industries Corporation presently makes three speeds of dental film--Intermediate *BH*, Super speed *SBH*, and an Ultra-Rapid speed *UBH*.
KODAK	Eastman Kodak presently makes two speeds of film--Radia-Tized and Ultra-Speed. All Kodak dental film code numbers are preceded by *DF* followed by a number. Kodak no longer makes "Regular" and "Super-Speed". Kodak *dental* films incorporate a "Morlite" feature which allows a higher intensity of light in the darkroom when used with the *ML-2* safelight filter. A Wratten 6 *B* safelight filter is required for Kodak extra-oral films such as Royal Blue, Blue Brand and No-Screen Medical X-ray Film. Kodak markets a 5" x 12" film for use with the XRM Panorex.
MINIMAX	Minimax Company presently makes two speeds of film--Intermediate and Extra Fast. The Intermediate speed film is identified by the letter *B* in its coding. The Extra Fast has the letters *EF* in its coding.
ORAGRAPHIC	Oragraphic presently makes two speeds of film--Intermediate and Super speed. The Intermediate speed film is identified by *OR-1* in its code. The Super speed is identified as *OSS-1* in its code. (Until it has been assigned IBM code numbers, Oragraphic will be referred to as *99*-other.)
RINN	Rinn Corporation presently makes three speeds of film. Medium *MF*, Extra *EF*, and Super *S*. The Rinn film code identifications include the code letters *MF*, *EF* or *S* followed by a number or a letter and number code, indicating the film size and number of films per packet. Their bitewing film is identified by a number preceding the code letters. Rinn *dental* films *MF* and *S* incorporated a "Pluslight" feature which allows a higher intensity of light in the darkroom when used with the *ML-2* safelight filter. (Rinn no longer markets their *DC*, *HF*, or *SF* dental films. The Rinn Super *S* replaces the Rinn Superfast *SF* and has the "Pluslight" feature.) Rinn also manufactures a 5" x 12" film for use with the *XRM* Panorex.
OTHER	Any other available film not included above will be listed as *99*-Other. Other brands of film which may be encountered are: Gavaert, Dentus Rapid: Ilford, Contrast and Standard: Cea, Normal and Rapid. These are generally films of foreign manufacture.

AMERICAN STANDARD SPEED CLASSIFICATIONS FOR INTRA-ORAL DENTAL RADIOGRAPHIC FILM: DIAGNOSTIC GRADE

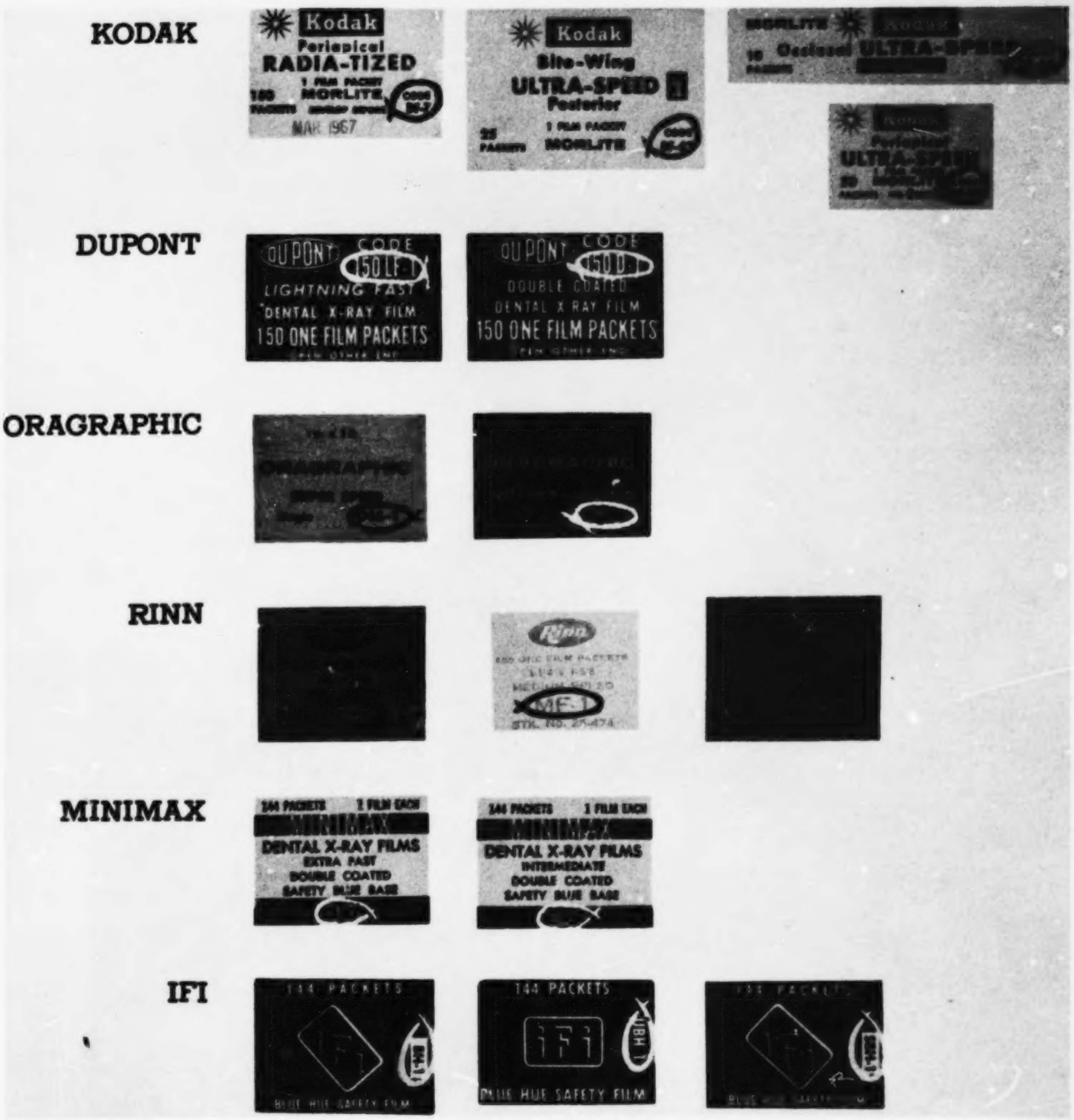
Table XII-a. Dental Roentgenographic Film Speed-Group Ratings*
(data furnished by the manufacturers)

Film brand	Manufacturer or distributor	Speed group (A.S.A. PH6.1-1961)	Speed group (In reciprocal roentgens)‡
Periapical film			
None	---	A (slowest)	1.5-3.0
DuPont "D"	E.I. duPont de Nemours & Co.	B	3.0-6.0
Kodak Radio-Tized (Morelite)	Eastman Kodak Co.		
IFI BH 1	International Film Industries		
Minimax Intermediate	Minimax Co.		
Rinn MF	Rinn Corp.		
IFI SBH 1	International Film Industries	C	6.0-12.0
Minimax Extra Fast	Minimax Co.		
Rinn EF	Rinn Corp.		
DuPont "LF"	E.I. duPont de Nemours & Co.	D	12.0-24.0
IFI UBH-1	International Film Industries		
Kodak Ultra-Speed (Morelite)	Eastman Kodak Co.		
Rinn S.F., S	Rinn Corp.		
None	---	E	24.0-48.0
None	---	F (fastest)	48.0-96.0
Bitewing film			
DuPont "BW"	E.I. duPont de Nemours & Co.	B	3.0-6.0
IFI Interproximal Standard	International Film Industries		
Kodak Radio-Tized (Morelite)	Eastman Kodak Co.		
Minimax Intermediate	Minimax Co.		
Rinn MF	Rinn Corp.		
IFI Interproximal Super	International Film Industries	C	6.0-12.0
Minimax Extra Fast	Minimax Co.		
Rinn EF	Rinn Corp.		
IFI Interproximal Ultra	International Film Industries	D	12.0-24.0
Kodak Ultra-Speed (Morelite)	Eastman Kodak Co.		
Rinn SF, S	Rinn Corp.		
Occlusal film			
Kodak Ultra-Speed (Morlite)	Eastman Kodak Co.	D	12.0-24.0
Rinn SF	Rinn Corp.		

* The method of calculating film speeds has been discussed in JADA 59:472 Sept. 1959.

‡ The upper limit of each speed group range shall be excluded from that range.

LOCATION OF CODE NUMBER OF THE VARIOUS FILMS


KODAK
Kodak
Periapical
RADIA-TIZED
MORLITE
MAR 1967
Kodak
Bite-Wing
ULTRA-SPEED
Posterior
MORLITE
ULTRA-SPEED
DUPONT
DUPONT CODE
150 LF-1
LIGHTNING FAST
DENTAL X-RAY FILM
150 ONE FILM PACKETS
DUPONT CODE
150 D
DOUBLE COATED
DENTAL X RAY FILM
150 ONE FILM PACKETS
ORAGRAPHIC
ORAGRAPHIC
RINN
Rinn
MF-1
MINIMAX
144 PACKETS 1 FILM EACH
DENTAL X-RAY FILMS
EXTRA FAST
DOUBLE COATED
SAFETY BLUE BASE
144 PACKETS 1 FILM EACH
DENTAL X-RAY FILMS
INTERMEDIATE
DOUBLE COATED
SAFETY BLUE BASE
IFI
144 PACKETS
IFI
BLUE HUE SAFETY FILM
144 PACKETS
IFI
IBH-1
BLUE HUE SAFETY FILM
144 PACKETS
IFI
BLUE HUE SAFETY FILM

FILM BADGE SERVICE

The amount of X-ray radiation that reaches the body of the dentist or of the auxiliary dental personnel can be measured economically with a film badge. The film badge is worn on the clothing for one or two weeks or for one month and is then returned by mail to the laboratory where it was purchased originally. At the laboratory, the film in the badge is carefully processed, and its exposure is evaluated. The amount of radiation recorded by the film badge is a measure of the exposure of the wearer. He is notified by mail of the amount of his exposure.

Film badges can be obtained on a weekly, biweekly, or monthly basis. Some laboratories require contracts which state that film badges will be accepted for a minimum of 13 consecutive weekly, biweekly, or monthly periods. Other laboratories set no limit on the minimum length of time for which the service is desired.[1]

Following is a list of commercial companies and organizations known to have a program for film badge monitoring. The list does not necessarily include *all* organizations which have a film badge program. This does not constitute an endorsement or a recommendation of the companies listed.

Applied Health Physics, Inc.
Bethel Park
Pennsylvania

Atomic Energy Industrial
Laboratory of the Southwest
6413 South Main
Houston, Texas

Controls for Radiation, Inc.
130 Alewife Brook Parkway
Cambridge, Massachusetts

Eberline Instrument Corporation
805 Early Street
Santa Fe, New Mexico

Gardray Film Badge Service
P. O. Box 117
Burlington, Massachusetts

Health Physics Services, Inc.
1109-13 Low Street
Baltimore 2, Maryland

Nuclear Chicago Corporation
333 East Howard Avenue
Des Plaines, Illinois 60018

Nuclear Consultants Corporation
Box 6172, Lambert Field
St. Louis, Missouri 63145

Nuclear Service Laboratories
Box 1885
Knoxville 1, Tennessee

Nucleonic Corporation of America
196 De Graw Street
Brooklyn 31, New York

R. S. Landauer, Jr. and Company
3920 216th Street
Matteson, Illinois

Radiation Detection Company
385 Logue Avenue
Mountain View, California

St. John X-ray Laboratory
Califon
New Jersey

T. M. Gaines Company
845 University Avenue
Berkeley 10, California

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[1] Barr, J. H.; Silha, R. E.; Richards, A. G.: Effective Use of X-ray Radiation in Dentistry.O.S., O.M. & O.P., Vol. 16: pp. 299-300, Mar. 1963.

Film Badge Service (continued)

Technical Associates
Nuclear Instrumentation
140 West Providencia Ave.
Burbank, California 91502

Tracerlab
A Division of Laboratory for
Electronics, Incorporated
1601 Trapelo Road
Waltham 54, Massachusetts

United States Testing Company,
Inc.
1415 Park Street
Hoboken, N.J. 07030

Westinghouse Radiation Monitor
Westinghouse X-ray Department
2519 Wilkens Avenue
Baltimore 3, Maryland

Conversion to Fast Film

Scatter Exposure

Collimation with Illustrations

Duty Cycle

SUGGESTIONS FOR CONVERSION TO ULTRA-FAST TECHNIQUE

Because different X-ray units vary considerably in their X-ray output and since individual preferences result in a wide variety of opinions regarding optimum density of radiograms, the exposure times suggested below may be modified somewhat in order to achieve the film quality desired.

If mAs is the milliampere-second value for the area to be radiographed (see suggested values in Table I), and mA is the new, reduced milliampere setting selected by the operator, exposure times for ultrafast techniques to be used with units having mechanical timers may be calculated using the following formula:

$$\text{Exposure Time} = \frac{\text{mAs}}{\text{mA}}$$

Table I

Suggested mAs Values for use in
Preparing a New Technique Chart using
Ultra-Fast Film Emulsions with Older
65 kVp X-ray Units

		Short (8") Cone	Long (16") Cone
Maxillary:	Central	2.5 mAs	10.0 mAs
	Lateral	2.0 mAs	7.5 mAs
	Cuspid	2.0 mAs	7.5 mAs
	Bicuspid	2.5 mAs	10.0 mAs
	Molar	3.75 mAs	15.0 mAs
Mandibular:	Central	2.0 mAs	7.5 mAs
	Lateral	2.0 mAs	7.5 mAs
	Cuspid	2.0 mAs	7.5 mAs
	Bicuspid	2.0 mAs	7.5 mAs
	Molar	2.5 mAs	10.0 mAs

For example, if you use a short (8") cone and 65 kVp, you could choose to set the milliamperes on your unit at 4 mA and use the following exposure times for the various areas (Table 2):

*Table 2

Sample Technique Chart
(65 kVp, 4 mA)

		Exposure Time
Maxillary:	**Central**	**1/2 - 3/4 seconds**
	Lateral	**1/2 second**
	Cuspid	**1/2 second**
	Bicuspid	**1/2 - 3/4 seconds**
	Molar	**1 second**
Mandibular:	**Central**	**1/2 second**
	Lateral	**1/2 second**
	Cuspid	**1/2 second**
	Bicuspid	**1/2 second**
	Molar	**3/4 second**

***These exposure times were calculated using the mAs values given in Table I.**

If, after setting up a new technique such as just described, the X-ray unit fails to produce consistent film densities at the shorter exposure time settings, try a further reduction in milliampere setting, and *increase* the exposure time accordingly.

Users of long cones can convert to the faster film technique in the same manner as described, but must use the mAs values listed in the long (16") cone column of Table I when calculating the exposure times for the technique chart. Ordinarily, units using long cones need only slight reduction of milliamperes to extend the exposure times into an accurate mechanical timer range. In many cases the recommended exposure times given by the film manufacturer may be used directly, without any reduction in milliampere setting.

RADIATION EXPOSURE TO OPERATOR FROM SCATTER RADIATION

The exposure or dose (D) is the product of the intensity of radiation and the exposure time (t), or D = I x t. Since you are concerned only with X-rays, the exposure or dose D will be in Roentgens. You can measure the exposure time in any units (seconds, minutes, hours, etc.) that you desire. However, for convenience in calculating the exposure, the intensity and time will have to be converted to the same units of time; that is, the intensity of radiation will have to be in milliroentgens per second, or minute, or hour, depending on the unit in which you prefer to measure your total exposure time. However, for most of the portable radiation survey meters, the units used are milliroentgen/hr, or mR/hr.

For the calculations, consider one average case and use these factors. Assume that the operator stands in the same position while taking the radiographs. Consider scatter radiation only at the position of the operator.

EXAMPLE: Given--The average working situation of

A. 46 = number of dental films exposed per week
B. 1.3 seconds (secs) = average exposure time per film
C. 1200 mR/hr = intensity of scatter radiation from a phantom or patient, measured at a distance of three feet from the patient, and at a location of 45° from the direction of the X-ray beam during a bitewing exposure using 90 kVp.

To find--the radiation exposure to the operator per year.

With D = I x t, to solve for D you need both I and t, which were given. All that is needed is to convert to appropriate units.

Since I was given in mR/hr, calculate exposure time on the basis of a week. This will be the product of the number of films per week (46) and the average exposure time per week (1.3 seconds). Or,

$$\frac{46 \text{ films}}{\text{week}} \times \frac{1.3 \text{ secs}}{\text{film}} = \frac{59.8 \text{ seconds}}{\text{week}}$$

For simplicity in the following calculations, round off the 59.8 seconds to 60 seconds. The problem now is to convert 60 seconds to hours. Since there are 60 sec/min x 60 min/hr, or 3600 sec/hr, a total of 60 seconds is 60/3600 hours, or 1/60 hour. Therefore:

$$\begin{aligned} D &= It \\ &= 1200 \text{ mR/hr} \times 1/60 \text{ hr/week} \\ &= 20 \text{ mR/week} \end{aligned}$$

Your exposure would be approximately 20 mR/week. If occupationally exposed persons do not receive more that .1 R or 100 mR per week, they will not exceed the limits of exposure recommended by the National Committee on Radiation Protection. For more detailed information on the maximum permissible doses recommended by the National Committee on Radiation Protection, refer to the National Bureau of Standards Handbooks 59 and 76.

SAMPLE CALCULATION TO DETERMINE APERTURE SIZE FOR LEAD COLLIMATOR

I. Using the chart in the appendix, Dental X-ray Units - General Information, read off the "Focal Spot to Tip of Cone" distance in inches for the X-ray unit in question. (In this sample calculation a General Electric unit is used.)

Example: General Electric Focal Spot to Tip of Cone = 8"

II. Next, remove pointer cone and measure as accurately as possible the distance from tip of cone to location where the collimator will be installed (Y). (The side of the collimator nearest the tubehead is used in all measurements.) This distance is then subtracted from "Focal Spot to Tip of Cone Distance" (A) to give "Focal Spot to Collimator Distance" (B).

Example: Cone tip to collimator = 6.00"
∴ Focal spot to tip of cone (8") minus cone tip to collimator (6") = focal spot to collimator (2")
A - Y = B

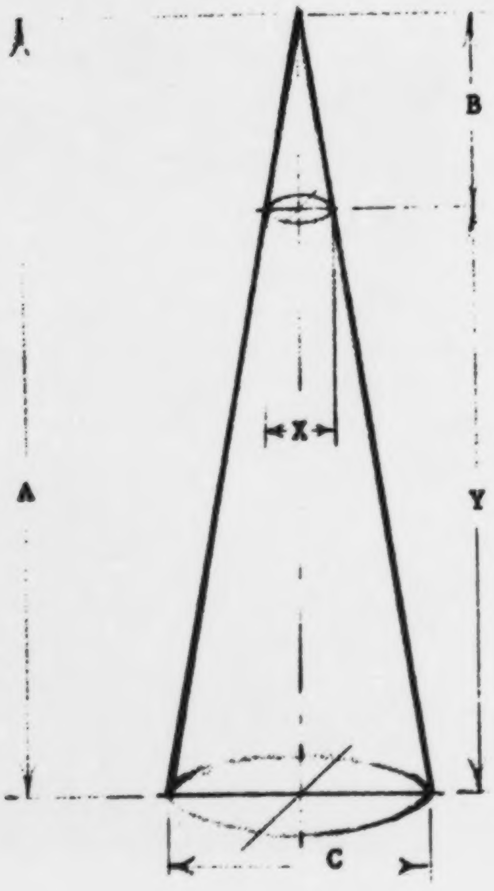
III. The desired beam size at tip of cone (C) is 2.75" in all cases.

Example: Beam size = 2.75"

IV. The aperture size (X) can now be determined by setting up a ratio of

$$\frac{\text{Focal Spot to Tip of Cone}}{\text{Focal Spot to Collimator}} = \frac{\text{Beam Size at Tip of Cone}}{\text{Aperture size in Collimator}}$$

Example: $\frac{8''}{2''} = \frac{2.75''}{x}$ $\quad 8x = 5.5''$ $\quad x = \frac{5.5}{8}$ $\quad x = 0.687''$



A = Focal Spot to Tip of Cone
Y = Cone Tip to Collimator
B = Focal Spot to Collimator
C = Beam Size at Tip of Cone
X = Aperture Size in Collimator

Equation:

$$\frac{A}{B} = \frac{C}{X}$$

INFORMATION ON PUBLIC HEALTH SERVICE FILTER AND COLLIMATOR SETS

The Public Health Service supplies filter and collimator sets for the five most commonly encountered dental X-ray machines. Although these are supplied by manufacturer's name, they will not necessarily fit all equipment marketed by that manufacturer. (The Public Health Service *collimators* do not fit Victor, GE-CDX-E or the Ritter E, F, and G models. The PHS *filters* do not fit the Ritter E, F, and G models.) The dimensions for these collimators are based upon a 2-3/4" diameter beam at the tip of the short pointer cone. The specifications for the filters and collimators supplied by the Public Health Service are as follows:

	OUTSIDE DIAMETER	APERTURE DIAMETER
Ritter	2.6 "	1.55"
Weber	1.44"	.89"
XRM	2.67"	.86"
GE	1.76"	.69"
Fischer	2.44"	1.57"

Collimators are made of 1/16" thick lead, also known as "four pound lead" because it weighs approximately 4 lbs/sq. ft.

Filters are made of 1/2 mm. commercially pure aluminum, #1100 or 2S.

CALCULATION USING DUTY CYCLE CORRECTION FACTOR

The duty cycle of an X-ray machine is the amount of time the tube can be operated per unit of time without causing damage to the tube. Dental X-ray machines can be operated only in terms of individual exposures, *not in terms of continuous operation over a long period of time*. Since the rate meters currently used in survey work read in terms of mR/hr, the duty cycle of an X-ray machine must be considered.

FOR EXAMPLE: If a surveyor checking tubehead leakage were to obtain a rate meter reading of 100 mR/hr at a distance of one meter, this reading might be misleading because the maximum possible continuous exposure time of a dental X-ray unit is far short of an hour. In fact, the average unit cannot be operated in excess of approximately six minutes in one hour. Therefore, it is necessary to calculate the true exposure dose rate from leakage at a distance of one meter, considering the operation limits of the equipment.

> 6 seconds in 1 minute = 6 minutes in 1 hour
>
> 6/60 of 1 hour = 1/10 = 0.1, the conversion factor.
>
> Multiply the rate meter reading (100 mR/hr) by the conversion factor (0.1) to obtain the true amount of leakage occurring within one hour with this particular X-ray unit.
>
> 100 mR/hr (rate meter reading) x 0.1 (conversion factor) = 10.0 mR,
>
> the amount of actual leakage in a one-hour period from this unit.

Handbook 76 allows a diagnostic tubehead leakage not to exceed 100 mR in one hour. The unit in question leaks 10 mR in one hour, or 0.1 of the maximum permissible amount.

The average conversion factor for dental X-ray units is one-tenth (0.1). When surveying equipment with the duty cycle unknown, use 0.1 as the conversion factor. This is a conservative average and allows for a safety factor of approximately 2.0. In using the conversion factor given, bear in mind that a specific milliamperage (mA) and kVp were used to calculate the conversion factors. If the mA or kVp is changed, the conversion factor given in the table will not be correct. The ma and kVp ratings used in Table I are, in general, the maximum so that the conversion factor is conservative and allows maximum safety.

DUTY CYCLE RATINGS FOR DENTAL X-RAY UNITS

Company	Model	Current (ma)	Voltage (kVp)	Duty Cycle (Continuous Operation)	Conversion Factor *
Ritter	A	10	63	6.5 secs. each min.	0.1082
	B	10	50-70	3.6 secs. each min.	0.060
	Dual-X	15	70	3.6 secs. each min.	0.060
	E (Century)	15	90	3 6 secs. each min.	0.060
	F	15	90	3.6 secs. each min.	0.060
	G	15	90	3.6 secs. each min.	0.060
	Mark 75	15	75		
GE	Victor (Old Style)	10	53	Unknown	
	CDX-E	10	65	Unknown	
	70 & 70-II	10	70	6 secs. each min.	0.10
	90 & 90-II	15	90	6 secs. each min.	0.10
	73	10	70	6 secs. each min.	0.10
	100	15	100	4 secs. each min.	0.0666
XRM	2A	15	70	4 secs. each min.	0.0666
	3A	15	70	4 secs. each min.	0.0666
	90	15	90	4 secs. each min.	0.0666
Weber	6	10	65	6 secs. each min.	0.10
	6A	10	65	6 secs. each min.	0.10
	6B	10	65	6 secs. each min.	0.10
	6R	15	70	4.2 secs. each min.	0.07
	7	10	65	6 secs. each min.	0.10
	7A	10	65	6 secs. each min.	0.10
	9A	10	65	6 secs. each min.	0.10
	11	10	65	6 secs. each min.	0.10
	11R	15	70	4.2 secs. each min.	0.07
	12R	15	90	2.4 secs. each min.	0.04
Fischer	DX	10	65	4 secs. each min.	0.0666
Norelco	D (Super 50)	7	50	3 secs. each min.	0.05

* Multiply the true exposure dose rate determined at one meter from the tube target by the correction factor to obtain the quantity of leakage radiation in one hour.

Reprinted from: "Measurement of Leakage Radiation from Dental X-ray Tube Housings". Radiological Health Data, II: 454-456, Oct. 1961

Aprons and Barriers

Barrier Materials

Personnel Monitoring Devices

LEAD APRONS, PROTECTIVE BARRIERS, AND PROTECTIVE BARRIER MATERIALS

Following are lists of commercial companies and organizations known to sell lead aprons, protective barriers, and protective barrier materials. The lists do not necessarily include *all* organizations handling these articles. These lists do not constitute an endorsement or recommendation of the organizations listed.

LEAD APRONS AND SHEETING

Bar-Ray Products, Inc., 209 25th Street, Brooklyn 32, New York

LeadX Protective Aprons	Office Personnel Patients' Aprons
Sheeting	.25 mm. lead equivalent .50 mm. lead equivalent 1.00 mm. lead equivalent

General Electric Company, X-ray Department, 4855 Electric Avenue,
Milwaukee, Wisconsin

Lead Protective Aprons	Office Personnel Patients' Aprons
Sheeting	.50 mm. lead equivalent

Picker X-ray Corporation, 25 South Broadway, White Plains, New York

Lead Protective Aprons	Office Personnel Patients' Aprons
Sheeting	.50 mm. lead equivalent 1.00 mm. lead equivalent

Buck-X-Ograph, 87 Xograph Avenue, St. Louis, Missouri

Buffalo Weaving & Belting Company, 300 Chandler, Buffalo, New York

Halsey X-ray Products, Inc., 1425 37th Street, Brooklyn, New York

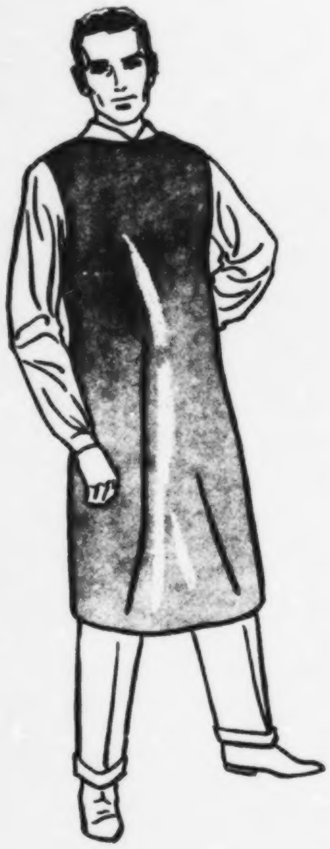
J. Palmero Sales Company, P. O. Box 368, Westport, Connecticut

Wolf X-ray Products, Inc., 93 Underhill Avenue, Brooklyn, New York

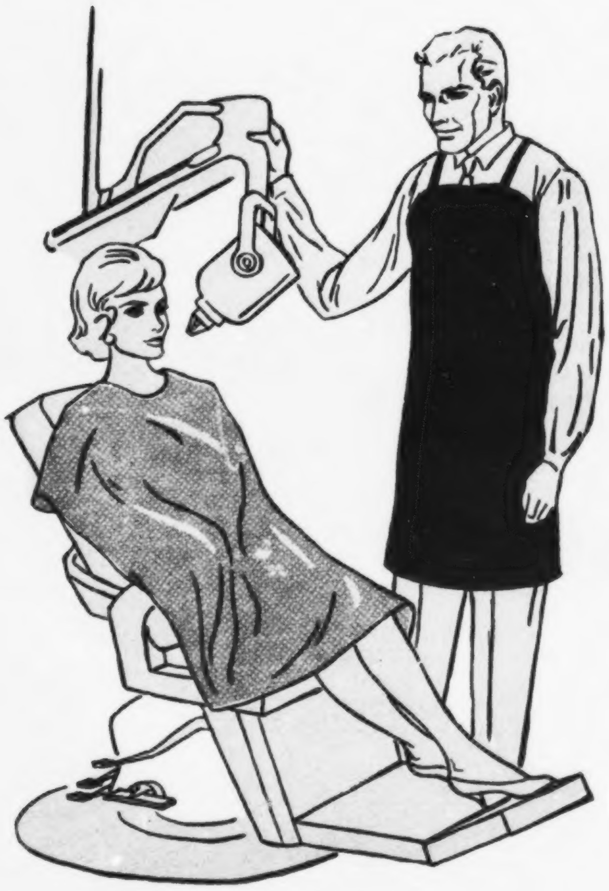
Rinn Corporation, 2929 N. Crawford Avenue, Chicago 41, Illinois

EXAMPLES OF LEAD APRONS

Pictured here are several of the various types of protective lead aprons for patient and office personnel. Aprons are made with a vinyl or rubber that is impregnated with finely powdered lead. The lead equivalent varies from .25 mm. lead equivalent to 1.00 mm. lead equivalent.

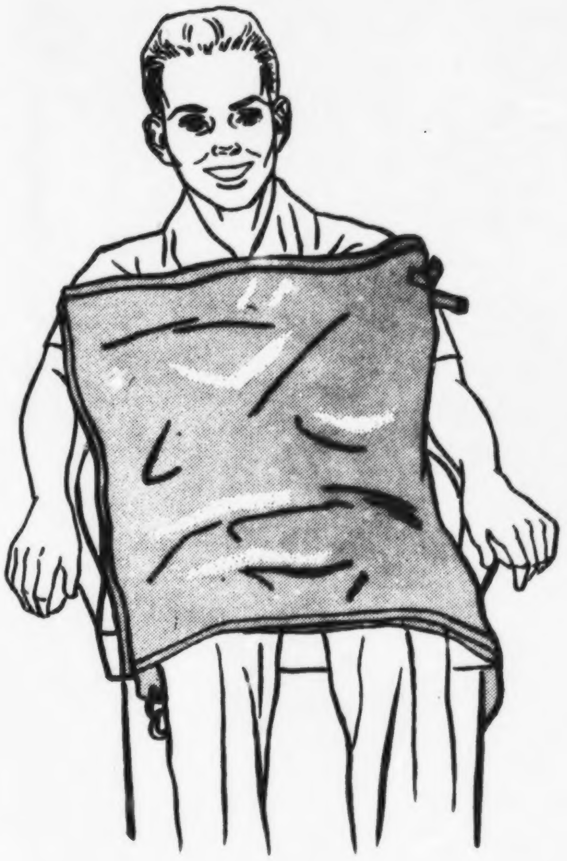


Coat Apron

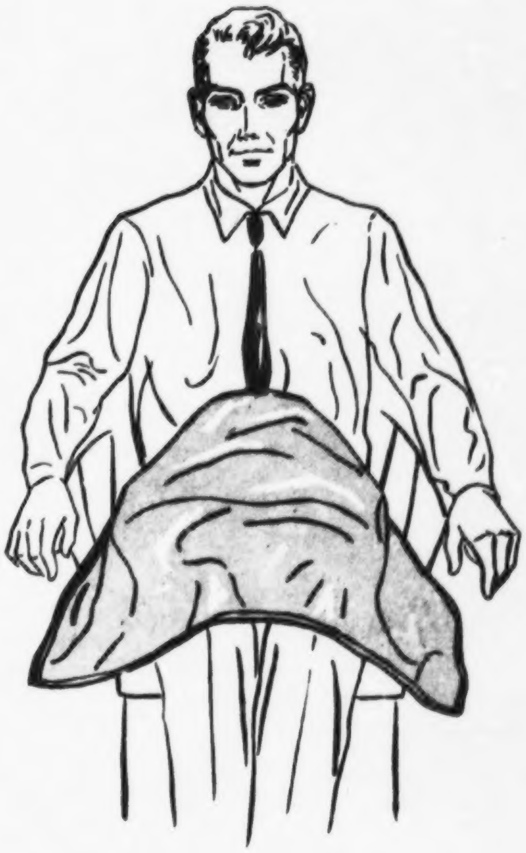


Bib Apron **Strap Apron**

Lead Aprons (continued)



Patient Apron



Lap Apron

PROTECTIVE BARRIERS

Bar-Ray Products, Inc., 209 25th Street, Brooklyn 32, New York

Floor Screen (Shield) 1.5 mm. lead-lined;
8" x 10" lead glass window

General Electric Company, X-ray Department, 4855 Electric Avenue,
Milwaukee, Wisconsin

Floor Screen 1.5 lead-lined;
8" x 10" lead glass window

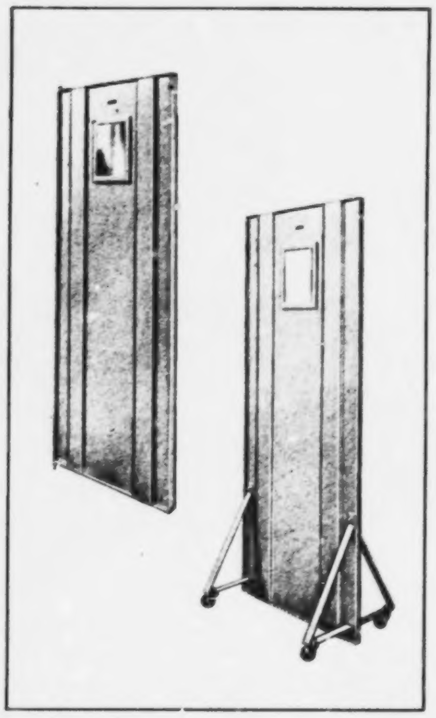
Picker X-ray Corporation, 25 South Broadway, White Plains, New York

Floor Screens 1.5 mm. lead-lined;
8" x 10" lead glass window

Campbell X-ray Transformer Company, 146 Exchange Street,
Malden, Massachusetts

Rinn Corporation, 2929 N. Crawford Avenue, Chicago 41, Illinois

Wolf X-ray Products, Inc., 93 Underhill Avenue, Brooklyn, New York

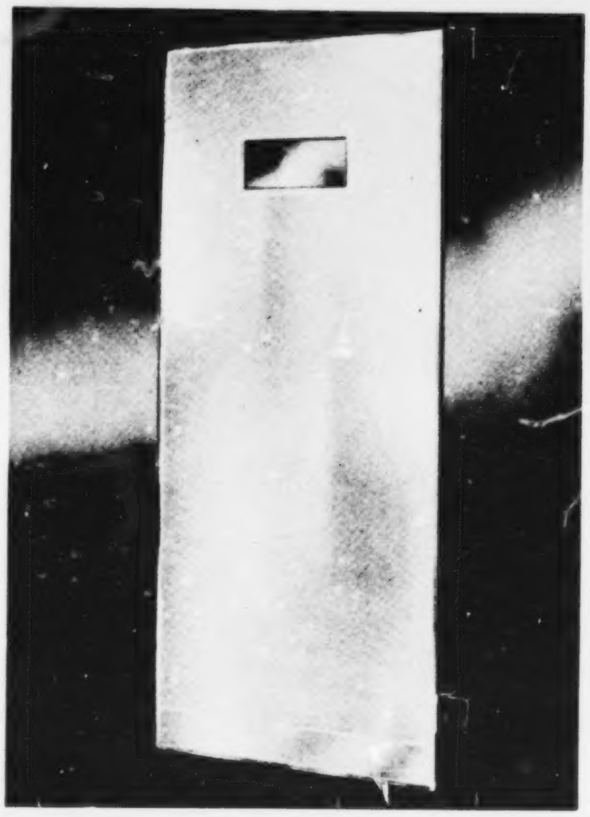


Pivoting Screen (left)
Mobile Screen (right)

Mobile Screen

Protective Barriers (continued)

Mobile Screen



Wall Pivoting Screen

Wall Pivoting Screen

PROTECTIVE BARRIER MATERIALS

Ameray Corp.
Route 46
Kenvil, New Jersey

Andel & Co., Inc.
5218 N. Kedzie Avenue
Chicago, Illinois

Bar-Ray Products, Inc.
209 25th Street
Brooklyn 32, New York

Division Lead Co.
7742 W. 61st Street
Summit, Illinois

Duro Metal Spinning Co.
207 Oster Street
Glen Olden, Pennsylvania

General Electric Co., X-ray Dept.
4855 Electric Avenue
Milwaukee, Wisconsin

General Lead Construction Corp.
1800 Harrison Avenue
Kearney, New Jersey

Keleket Division
(Laboratory for Electronics, Inc.)
Medical X-ray Apparatus
1601 Trapelo Road
Waltham, Mass.

Keller Products, Inc.
37 Union
Manchester, New Hampshire

O. G. Kelley & Co.
105 Taylor Street
Boston, Massachusetts

Maryland Metal Spinning Co.
604 W. Fairmount Avenue
Baltimore, Maryland

Met-L-Wood Corp.
6755 W. 65th Street
Chicago 38, Illinois

Picker X-ray Corp.
1273 Mamaroneck Avenue
White Plains, New York

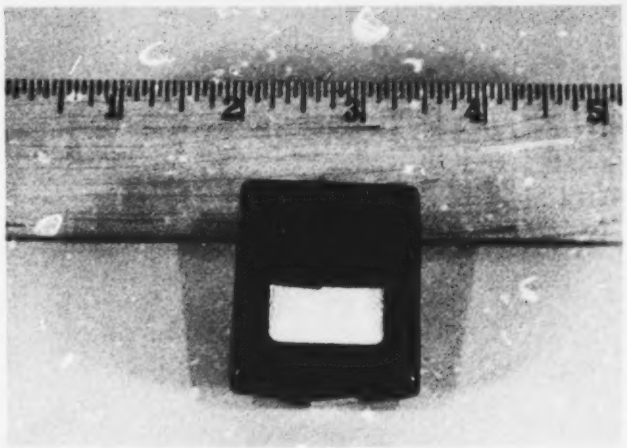
Ray Proof Corp.
843 Canal Street, P.O. Box 1454
Stamford, Connecticut

Westinghouse Electric Corp.
X-ray Dept, 2519 Wilkins Avenue
Baltimore, Maryland

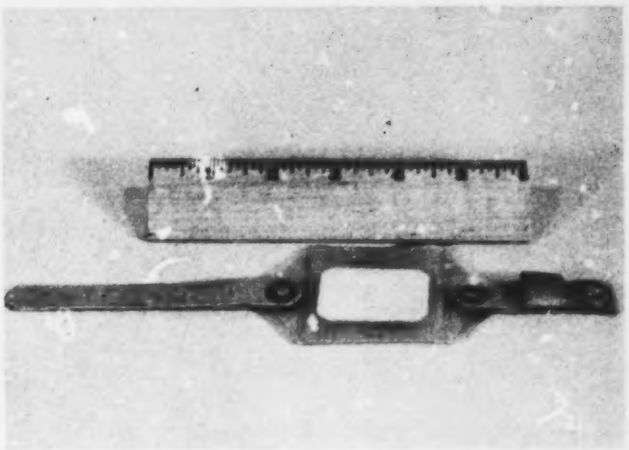
Wolf X-ray Products, Inc.
93 Underhill Avenue
Brooklyn 38, New York

PERSONNEL MONITORING DEVICES

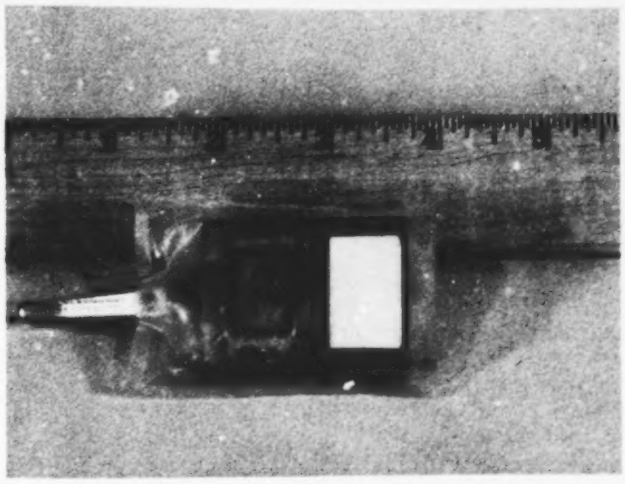
Film Badges



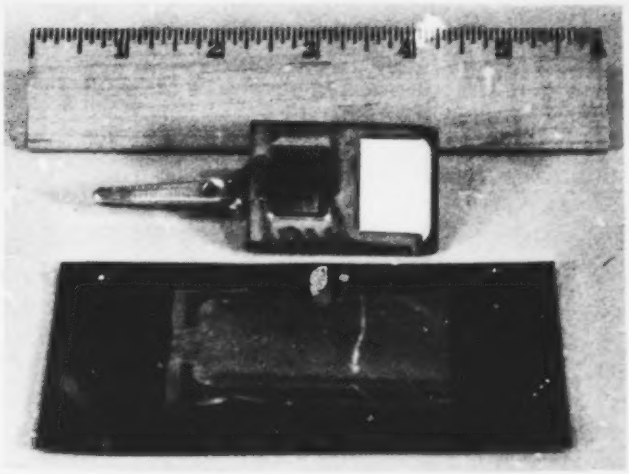
Clip-on Badge



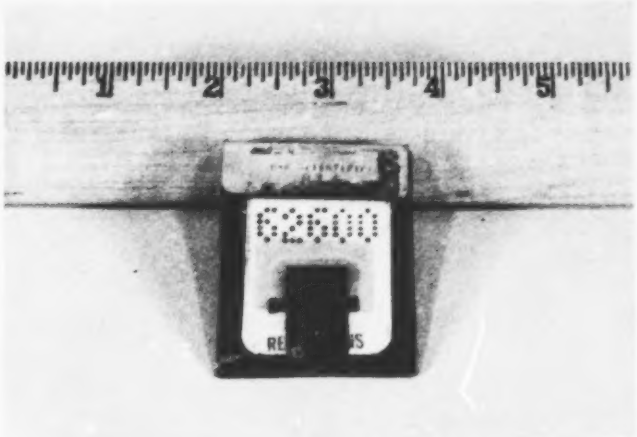
Wrist Badge



Clip-on Badge in Plastic Cover

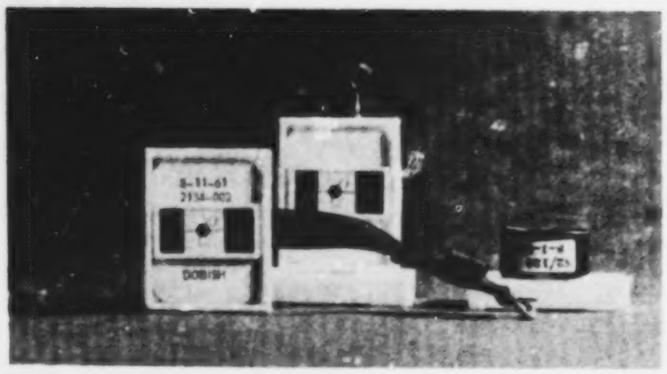


Clip-on Badge with Plastic Cover
Removed



Back Side of Film Badge

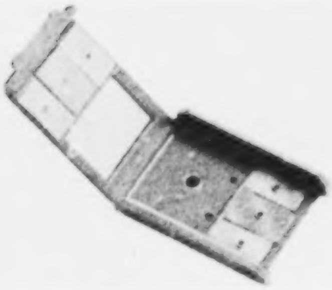
Film Badges (continued)



Wrist Clip-on Ring

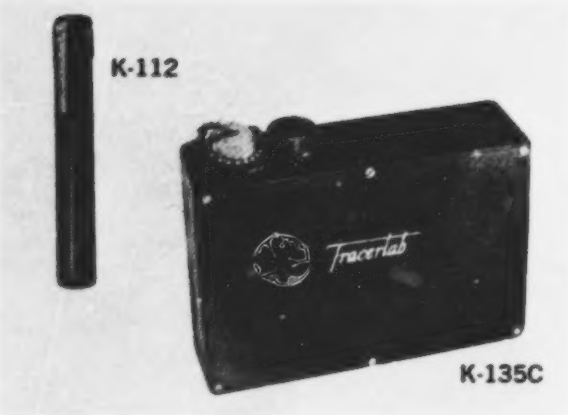
NCA-3
M. Bowman
11-14-60

Closed

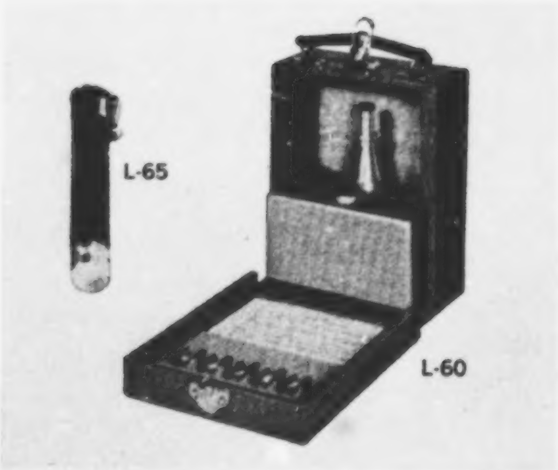


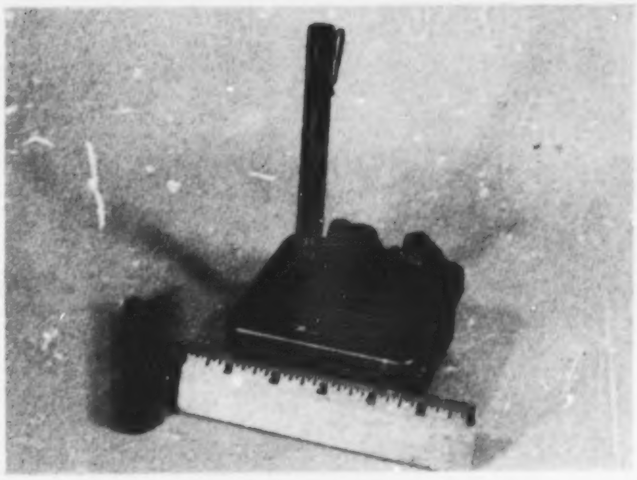
Opened

Dosimeters and Chargers

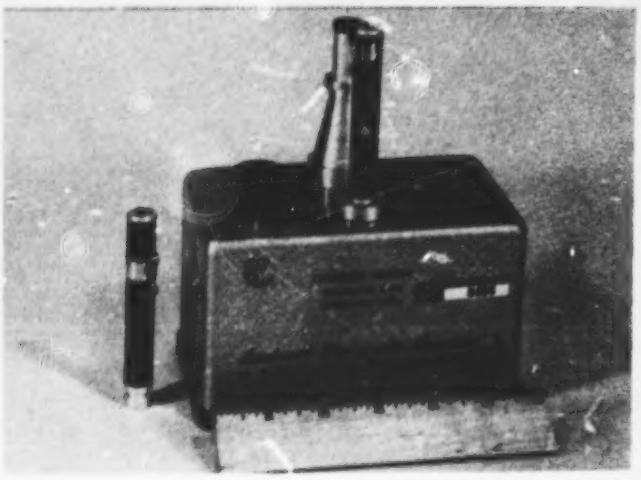

K-112
Tracerlab
K-135C

Pocket Chambers and Charger Readers



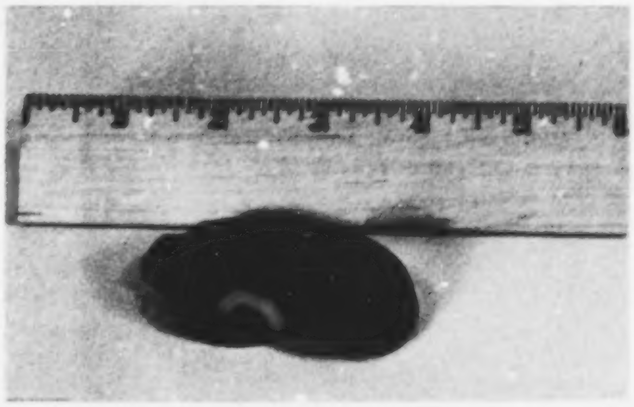


Pocket Dosimeter and Charger

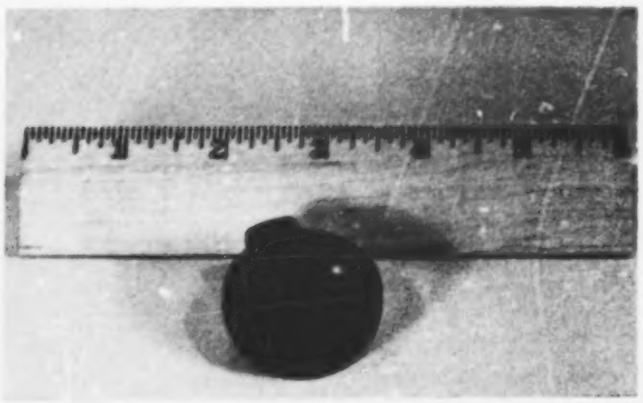


Pocket Chamber and Charger-Reader

Dosimeters

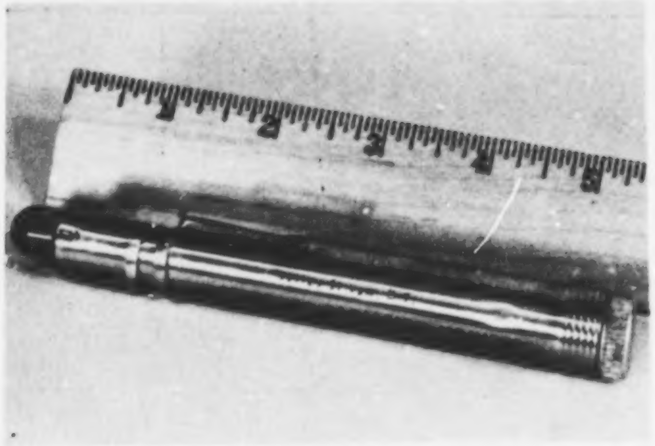


Glass Dosimeter Opened



Glass Dosimeter Closed

Warning Device



Chirpy

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PHYSICAL RADIATION PROTECTION SURVEY OF DENTAL X-RAY EQUIPMENT INSTALLATION
CARD NO. 1

2. STATE, COUNTY, CITY | 1 | 3 | 0 | 4 | 6 | 2 | 6 | 8 |
1 2 3 4 5 6 7 8

3. DENTIST, CARD IDENTIFICATION | 0 | 1 | 0 | 8 | 9 | 1 | 3 |
9 10 11 12 13 14 15

1.
A. Drs. Yankem and Pullem
NAME OF USER(S)
B. 1001 Marginal Ridge Way
INSTALLATION ADDRESS
C. CAries 5-4321
PHONE NUMBER
D. Gamma
CITY
E. Photon
COUNTY
F. Indiana
STATE
G. Philip Saint Costep
NAME OF SURVEYOR

4. TOTAL X-RAY UNITS AT INSTALLATION | 1 |
16

5. X-RAY UNIT IDENTIFICATION NUMBER | 1 |
17

6. NUMBER OF PERSONS OPERATING THIS UNIT | 4 |
18

7. NUMBER OF OFFICE PERSONNEL
A. FULL TIME DENTISTS | 2 |
19
B. PART TIME DENTISTS | 1 |
20
C. OTHER FULL TIME PERSONNEL | 2 |
21
D. OTHER PART TIME PERSONNEL | 1 |
22

8. TYPE OF PRACTICE
1. GENERAL ____
2. ORAL SURGERY ____
3. ORTHODONTIC ____
4. PEDODONTIC ____
5. PERIODONTIC ✓
6. PROSTHODONTIC ____
7. MORE THAN ONE TYPE ____
9. OTHER (SPECIFY) ____

| 5 |
23

9. X-RAY UNIT
A. MANUFACTURER Ritter MODEL B | 0 | 2 |
24 25

B. TUBE SERIAL NUMBER 9B23250 | 0 | 0 | 9 | B | 2 | 3 | 2 | 5 | 0 |
26 27 28 29 30 31 32 33 34

C. CONSOLE SERIAL NUMBER 8B23250 | 0 | 8 | B | 2 | 3 | 2 | 5 | 0 |
35 36 37 38 39 40 41 42

10. POINTER CONE
0. NONE
1. SHORT POINTED ____
2. SHORT OPEN ____
3. LONG POINTED ____
4. LONG OPEN ✓
9. OTHER (SPECIFY) ____

| 4 |
43

11. FIELD DIAMETER AT END OF POINTER CONE (inches)
A. BEFORE MODIFICATION 5.50 | 5 . | 5 | 0 |
44 45 46
B. AFTER MODIFICATION 2.75 | 2 . | 7 | 5 |
47 48 49

12. TOTAL FILTRATION OF PRIMARY BEAM (mm Al equiv.)
A. BEFORE MODIFICATION 0.5 | 0 . | 5 | 0 |
50 51 52
B. AFTER MODIFICATION 2.0 | 2 . | 0 | 0 |
53 54 55

13. ROENTGEN OUTPUT AT END OF POINTER CONE IN r/sec.
A. BEFORE MODIFICATION 13/6 | 2 | 1 | 6 |
56 57 58
B. AFTER MODIFICATION 12/9 | 1 | 3 | 3 |
59 60 61

14. IS X-RAY UNIT OPERABLE AT LEAST 6 FEET FROM TUBE HEAD
0. NO ✓
1. YES ____

| 0 |
62

15. TIME
SURVEY BEGAN 12:01 SURVEY ENDED 12:31 PM DIFFERENCE IN MINUTES | 3 | 0 |
63 64

16. DATE OF SURVEY
(MONTH/DAY/YEAR) January 4, 1964 record month and year | 0 | 1 | 6 | 4 |
65 66 67 68

17. FURTHER CONSULTATION RECOMMENDED
0. NO ✓
1. YES (SEE REMARKS) ____

| 0 |
69

18. CODE NUMBER OF SURVEYOR
Costep and Alcox | 1 | 3 |
70 71

PHS-3657
Rev 5-61

Form Approved
Budget Bureau No. 68-R733

CARD NO. 2	IDENTIFICATION	1	3	0	4	6	2	6	8	0	1	0	8	9	2	3	1	1
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

19. TIMER

A. TYPE 0. NONE ____ 1. MECHANICAL ✓ 2. ELECTRICAL OR ELECTRONIC ____ 1
18

B. TERMINATES EXPOSURE 0. NO ✓ 1. YES ____ B. UNKNOWN ____ 0
19

C. STOPWATCH CHECK TIMER SETTING 12 STOPWATCH READING 14 Electronic Timer is coded "c" - not applicable DIFFERENCE 2
20

20. X-RAY UNIT GROUNDED

0. NO ____ 1. YES ____ B. UNKNOWN ✓ B
21

21. STABILITY OF TUBE HEAD

0. ADEQUATE ____ 1. NOT ADEQUATE ✓ 1
22

22. TUBE HOUSING RADIATION LEAKAGE WITHIN RECOMMENDED STANDARDS

0. NO ✓ 1. YES ____ 0
23

23. PROTECTIVE BARRIERS

0. NONE ____
1. FIXED WITH LEAD WINDOW ____
2. FIXED WITH NO LEAD WINDOW ____
3. MOBILE WITH LEAD WINDOW ____
4. MOBILE WITH NO LEAD WINDOW ____
5. PRESENT BUT NOT IN USE ✓
9. OTHER (SPECIFY) ____

5
24

24. LEAD APRONS

0. NONE ____
1. OPERATOR ONLY ____
2. PATIENT ONLY ____
3. BOTH OPERATOR AND PATIENT ____
4. PRESENT BUT NOT IN USE ✓

4
25

25. PERSONNEL MONITORING

A. TYPE
0. NONE
1. FILM BADGE ____
2. POCKET CHAMBER
3. POCKET DOSIMETER ✓
4. DENTAL FILM ____
9. OTHER (SPECIFY) ____

3
26

B. TIME
0. NONE ____
1. CURRENTLY BEING USED ____
2. WAS USED WITHIN THE PAST 12 MOS ✓
3. WAS USED OVER ONE YEAR AGO ____

2
27

C. RESULTS
0. NONE ____
1. UNDETERMINED ✓
2. BELOW 25 mr/wk ____
3. 25 TO 100 mr/wk ____
4. ABOVE 100 mr/wk ____

1
28

26. WORKLOAD

A. ESTIMATED NUMBER OF FILMS PER WEEK ON THIS UNIT 46 | 0 | 4 | 6 | (29 30 31)

B. AVERAGE EXPOSURE TIME PER FILM OF UPPER FIRST MOLAR 2¼ | 2.25 | (32 33 34)

C. CALCULATED AVERAGE EXPOSURE TIME PER FILM (in seconds) 2.25 x .7 = 1.57 | 1.57 | (35 36 37)
(AVG. EXP. = UP. MOLAR X .7)

D. USUAL MILLIAMPERES 10 | 1 | 0 | (38 39)

E. MILLIAMPERE-SECONDS PER WEEK 722 | 0 | 7 | 2 | 2 | (40 41 42 43)

F. USUAL KILOVOLTAGE 65 | 6 | 5 | (44 45)

27. FILM USED

A. BITEWING MANUFACTURER Dupont TYPE OR CODE 150 D-1 | 2 | 9 | (46 47)

B. PERIAPICAL MANUFACTURER Dupont TYPE OR CODE 150 D-1 | 2 | 9 | (48 49)
LIST OTHER FILMS UNDER REMARKS

28. DARKROOM PROCEDURES

A. DEVELOPER USED MANUFACTURER GE TYPE Super mix | 0 | 5 | (50 51)

B. USUAL DEVELOPMENT TIME (in minutes) 5 | 5.0 | (52 53)

C. USUAL TEMPERATURE OF DEVELOPER (in degrees fahrenheit) 70° | 7 | 0 | (54 55)

D. THERMOMETER IN DARKROOM 0. NO ____ 1. YES ____ 2. THERMOSTATIC CONTROL ✓ 3. NO DARKROOM ____ 2
56

E. USUAL CHANGE OF DEVELOPER (in weeks) 3 | 0 | 3 | (57 58)

F. IS DARKROOM LIGHT TIGHT 0. NO ✓ 1. YES ____ 0
59

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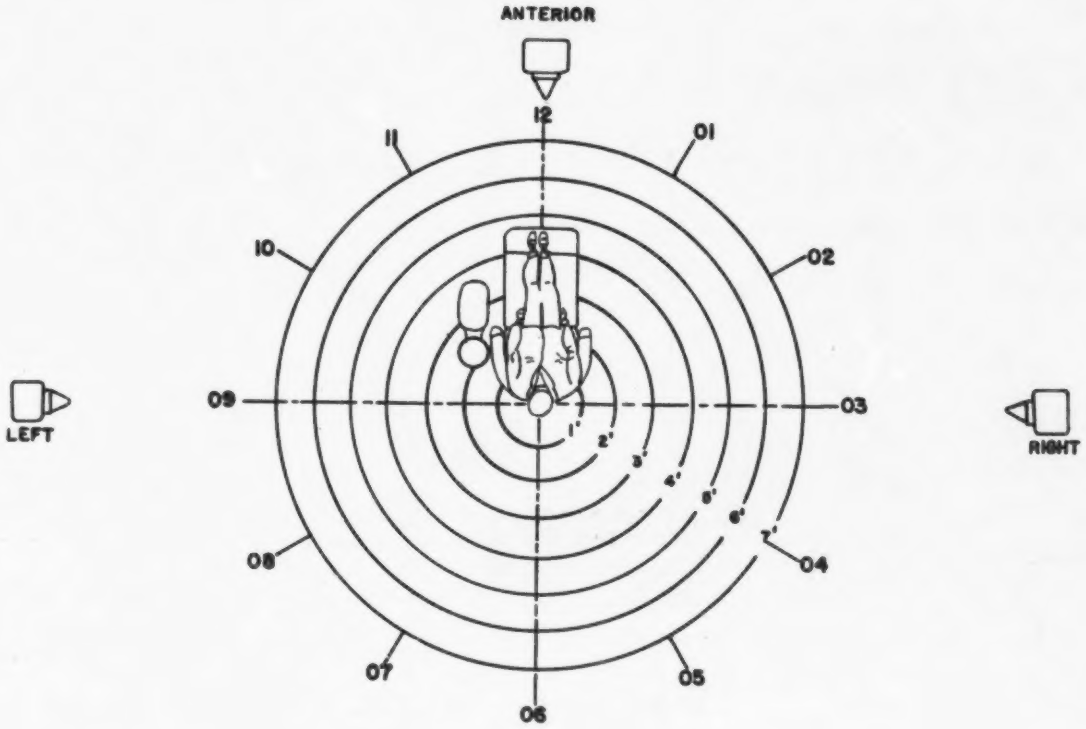
CARD NO. 3	IDENTIFICATION																
		1	3	0	4	6	2	6	8	0	1	0	8	9	3	3	1	1
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

29. OCCUPATIONAL EXPOSURE; SCATTER RADIATION (REFER TO DIAGRAM BELOW).

	AT NORMAL OPERATING POSITION			AT NEW POSITION
	DIRECTION	DISTANCE	mr/hr	mr/hr
I LEFT BITEWING EXPOSURE				
A. DENTIST	0 9	1	1 5 0 0	0 0 2
	18 19	20	21 22 23 24	25 26 27
B. ASSISTANT	0 2	2	1 9 5 0	0 0 1
	28 29	30	31 32 33 34	35 36 37
II ANTERIOR UPPER PERIAPICAL EXPOSURE	DIRECTION	DISTANCE	mr/hr	mr/hr
C. DENTIST	1 2	1	1 6 0 0	0 0 3
	38 39	40	41 42 43 44	45 46 47
D. ASSISTANT	0 2	2	1 2 0 0	0 0 1
	48 49	50	51 52 53 54	55 56 57
III RIGHT BITEWING EXPOSURE	DIRECTION	DISTANCE	mr/hr	mr/hr
E. DENTIST	0 3	1	1 4 7 5	0 0 1
	58 59	60	61 62 63 64	65 66 67
F. ASSISTANT	0 1	2	1 7 0 0	0 0 0
	68 69	70	71 72 73 74	75 76 77



30.

TYPE OF SURVEY INSTRUMENT USED Nucor

1
78

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NOTE TIME SURVEY ENDED

CARD NO. 4	**IDENTIFICATION**	☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐ 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

31. BEAM QUALITY DETERMINATION (CAP ON/CAP OFF METHOD)

A. KVP FOR THIS EXPOSURE ________		☐☐ 18 19
B. MA FOR THIS EXPOSURE ________		☐☐ 20 21
C. CHAMBER A CAP OFF	TIME IN SECONDS________ NUMBER OF ROENTGENS________	ROENTGENS/SEC ☐☐☐ 22 23 24
D. CHAMBER B CAP OFF	TIME IN SECONDS________ NUMBER OF ROENTGENS________	ROENTGENS/SEC ☐☐☐ 25 26 27
E. CHAMBER A CAP ON	TIME IN SECONDS________ NUMBER OF ROENTGENS________	ROENTGENS/SEC ☐☐☐ 28 29 30
F. CHAMBER B CAP OFF	TIME IN SECONDS________ NUMBER OF ROENTGENS________	ROENTGENS/SEC ☐☐☐ 31 32 33
G. RATIO CAP ON / CAP OFF — CHAMBER A ________		☐☐☐ 34 35 36
H. HALF VALUE LAYER CALCULATED ________		☐☐☐ 37 38 39
I. TOTAL ALUMINUM EQUIVALENT FILTRATION ________		☐☐☐ 40 41 42

31. REMARKS

In most surveys this last page is not used and the "Remarks" item is for the benefit of the State conducting the survey.

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PHYSICAL RADIATION PROTECTION SURVEY REPORT OF DENTAL X-RAY EQUIPMENT INSTALLATIONS

CODING AND PUNCHING INSTRUCTIONS

Card #1

Item	Card Column	Code	Remarks	
2. Code Number				
State	1-2	01-51	From IBM Standard State Code	
County	3-5	001-999	From IBM Standard County Code	
City	6-8	001-999	From IBM Standard City Code	
3. Dentist Card Identification				
Dentist	9-13	00001-99999	Dentist's identification number assigned in consecutive order within the State	
			Card Identification	
Card	14-15	11 first form	First page	Card #1
		12 second form	First page	Card #1
		22 second form	Second page	Card #2
		13 third form	First page	Card #1
		23 third form	Second page	Card #2
		33 third form	Third page	Card #3
		14 fourth form	First page	Card #1
		24 fourth form	Second page	Card #2
		34 fourth form	Third page	Card #3
		44 fourth form	Fourth page	Card #4
4. Number of x-ray units	16	A - not stated 0 - none 1 - 1 unit 2 - 2 units 3 - 3 units 9 - 9 or more units	As reported - If zero, then punch zeroes in columns 24-62	
5. Number assigned to this unit	17	A - not stated 0 - none 1 - first unit 2 - second unit 3 - third unit 9 - ninth unit	As reported - assigned by surveyor	

Item	Card Column	Code	Remarks
6. Number of persons operating this unit	18	A - not stated 1 - 1 person 2 - 2 persons 3 - 3 persons 9 - 9 or more persons	As reported
7. Number of Office Personnel			
A. Full-time Dentists	19	A - not stated 1 - 1 dentist 2 - 2 dentists 3 - 3 dentists 9 - 9 or more dentists	As reported
B. Part-time Dentists	20	A - not stated 0 - none 1 - 1 dentist 2 - 2 dentists 3 - 3 dentists 9 - 9 or more dentists	As reported
C. Other full-time personnel	21	A - not stated 0 - none 1 - 1 person 2 - 2 persons 3 - 3 persons 9 - 9 or more persons	As reported
D. Other part-time personnel	22	A - not stated 0 - none 1 - 1 person 2 - 2 persons 3 - 3 persons 9 - 9 or more persons	As reported
8. Type of practice	23	A - not stated 1 - General 2 - Oral Surgery 3 - Orthodontic 4 - Pedodontic 5 - Periodontic 6 - Prosthodontic 7 - more than one type 9 - other	As reported NOTE: Clinics, hospitals, military installations, etc. will be coded as 9

Item	Card Column	Code	Remarks
9. X-ray Unit			
A. Manufacturer and Model	24-25	AA - not stated BB - unknown 01-99 See attachment A	As reported - manufacturer and model
B. Tube serial number	26-34	AAAAAAAAA - not stated BBBBBBBBB - unknown 000000001-999999999	As reported
C. Console serial number	35-42	AAAAAAAA - not stated BBBBBBBB - unknown 00000001-99999999	As reported
10. Pointer cone	43	A - not stated B - unknown 0 - none 1 - Short-pointed 2 - Short-open 3 - Long-pointed 4 - Long-open 9 - Other	As reported
11. Field diameter at end of pointer cone (inches)			
A. Before Modification	44-46	A.AA - not stated B.BB - unknown 0.00 - none 0.25 - 1/4 inch 0.50 - 1/2 inch 2.75 - 2-3/4 inches 9.75 - 9-3/4 inches	As reported to nearest 1/4 inch in decimal form
B. After Modification	47-49	A.AA - not stated B.BB - unknown C.CC - not applicable 0.25 - 1/4 inch 0.50 - 1/2 inch 2.75 - 2-3/4 inches 9.75 - 9-3/4 inches	As reported to nearest 1/4 inch in decimal form. Code CCC if modification is not performed during survey. If no modification is necessary, code same number as before modification

Item	Card Column	Code	Remarks
12. Total Filtration of Primary Beam			
A. Before modification	50-52	A.AA - not stated B.BB - unknown 0.00 - none 0.25 - 1/4 mm 0.50 - 1/2 mm 1.50 - 1-1/2 mm 9.75 - 9-3/4 mm	As reported to nearest 1/4 millimeter in Aluminum equivalent in decimal form
B. After modification	53-55	A.AA - not stated B.BB - unknown C.CC - not applicable 0.25 - 1/4 mm 0.50 - 1/2 mm 1.50 - 1-1/2 mm 9.75 - 9-3/4 mm	As reported to nearest 1/4 millimeter of Aluminum equivalent in decimal form. Code CCC if modification is not performed during survey. If no modification is necessary, code same number as before modification.
13. Roentgen Output at end of pointer cone r/sec.			
A. Before modification	56-58	A.AA - not stated B.BB - unknown 0.00 - none 0.01 - 1/100 r/sec 0.05 - 1/20 r/sec 0.97 - 97/100 r/sec 1.50 - 1-1/2 r/sec 9.99 - 9-99/100 r/sec	As calculated from seconds and number of roentgens as read from integrated meter in 100ths of roentgens per sec. Code AAA if measurement is not made as part of the survey
B. After modification	59-61	A.AA - not stated B.BB - unknown C.CC - not applicable 0.01 - 1/100 r/sec 0.05 - 1/20 r/sec 0.97 - 97/100 r/sec 1.50 - 1-1/2 r/sec 9.99 - 9-99/100 r/sec	As calculated from seconds and number of roentgens as read from integrated meter in 100ths of roentgens per sec. Code CCC if modification is not performed during survey. Code AAA if measurement is not made part of the survey. If no modification is necessary, code same number as before modification

Item	Card Column	Code	Remarks
14. Is X-ray unit operable at least 6 feet from tube head?	62	A - not stated B - unknown 0 - no 1 - yes	As reported - Under 6 feet-No 6 feet or more - Yes * Assume no protective barrier in use
15. Time survey began and time survey ended	63-64	AA - not stated BB - unknown 01 - 1 minute 02 - 2 minutes 99 - 99 minutes	Code the difference between ending and starting time in minutes
16. Date of Survey	65-68	0361 - Mar. 1961 0861 - Aug. 1961 1161 - Nov. 1961 1261 - Dec. 1961 1262 - Dec. 1962 0163 - Jan. 1963 1269 - Dec. 1969	As reported
17. Further consultation recommended	69	A - not stated 0 - no 1 - yes	If "yes" it will be explained under remarks. Code as reported.
18. Code number of Surveyor	70-71	AA - not stated 01-99	As assigned

PHYSICAL RADIATION PROTECTION SURVEY REPORT OF DENTAL X-RAY EQUIPMENT INSTALLATIONS

CODING AND PUNCHING INSTRUCTIONS

Card #2

Item	Card Column	Code	Remarks
Code Number			
State	1-2	01-51	From IBM Standard State Code
County	3-5	001-999	From IBM Standard County Code
City	6-8	001-999	From IBM Standard City Code
Dentist identification	9-13	00001-99999	Dentist's identification number assigned in consecutive order within the State.
			Card Identification
Card identification	14-15	11 first form	First page Card #1
		12 second form	First page Card #1
		22 second form	Second page Card #2
		13 third form	First page Card #1
		23 third form	Second page Card #2
		33 third form	Third page Card #3
		14 fourth form	First page Card #1
		24 fourth form	Second page Card #2
		34 fourth form	Third page Card #3
		44 fourth form	Fourth page Card #4
Total x-ray units at installation	16	A - not stated 0 - none 1 - 1 unit 2 - 2 units 3 - 3 units 9 - 9 or more units	As reported
X-ray unit identification number	17	A - not stated 0 - none 1 - first unit 2 - second unit 3 - third unit 9 - ninth unit	As reported - assigned by surveyor

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Item	Card Column	Code	Remarks
19. Timer			
A. Type	18	A - not stated B - unknown 0 - none 1 - mechanical 2 - electrical or electronic	As reported

Item	Card Column	Code	Remarks
B. Terminates exposure	19	A - not stated B - unknown 0 - no 1 - yes	As reported
C. Stopwatch check	20	A - not stated B - unknown 0 - none 1 - 1 second 2 - 2 seconds 9 - 9 or more seconds	Difference between timer and stopwatch. As reported to nearest second either plus or minus. Applies only on machines with mechanical timers.
20. Is x-ray unit grounded?	21	A - not stated B - unknown 0 - no 1 - yes	As reported
21. Stability of Tube Head	22	A - not stated 0 - adequate 1 - not adequate	As reported
22. Tube housing radiation leakage within recommended standards	23	A - not stated B - unknown 0 - no 1 - yes	As reported - Code 0 - No. If reading at 1 meter exceeds 100 mr in one (1) hour after consideration is given to the limitation imposed by the duty cycle of the tube as determined from the manufacture tube rating and cooling charts. As a rule of thumb with dental x-ray units operated at the normal KVP and Ma settings, readings obtained car be divided by ten (10) to determine the leakage at the maximum voltage and current for continuous operation at that voltage.

Item	Card Column	Code	Remarks
23. Protective barrier	24	A - not stated 0 - none 1 - fixed - with lead window 2 - fixed - with no lead window 3 - mobile - with lead window 4 - mobile - with no lead window 5 - present - but not in use 9 - other	As reported - regard fixed wall as protective barrier if distance and material is adequate, then code as 9.
24. Lead apron	25	A - not stated 0 - none 1 - operator only 2 - patient only 3 - patient and operator 4 - present but not in use 9 - other	As reported - Code 9 if used only on children and pregnant women.
25. Personnel Monitoring			
A. Type	26	A - not stated 0 - none 1 - film badge 2 - pocket chamber 3 - pocket dosimeter 4 - dental film 9 - other	As reported - if more than one means is or has been used, record most recent or most accurate (1, 2, 3)
B. Time	27	A - not stated 0 - never 1 - currently being used 2 - used within past 12 months 3 - used over one year ago	As reported
C. Results	28	A - not stated 0 - none 1 - undetermined 2 - below 25 mr/wk 3 - 25 to 100 mr/wk 4 - above 100 mr/wk	As reported

Item	Card Column	Code	Remarks
26. Workload			
A. Estimated number of films per week on this unit	29-31	AAA - not stated BBB - unknown 000 - none 001 - 1 film/wk 999 - 999 films/wk	As reported for this unit only
B. Average exposure time per film of upper first molar	32-34	A.AA - not stated B.BB - unknown 0.00 - none 0.01 - 1/100 sec 0.02 - 1/50 sec 0.10 - 1/10 sec 1.00 - 1 sec 2.25 - 2-1/4 sec 9.99 - 9-99/100 sec	As reported to nearest 100th of a second in decimal form
C. Calculated average exposure time per film in seconds	35-37	A.AA - not stated B.BB - unknown 0.00 - none 0.01 - 1/100 sec 0.02 - 1/50 sec 0.10 - 1/10 sec 1.00 - 1 sec 2.25 - 2-1/4 sec 9.99 - 9-99/100 sec	As reported to nearest 100th of a second in decimal form. Obtained by multiplying average exposure time of upper first molar by correction factor of 7/10
D. Usual milliamperes	38-39	AA - not stated BB - unknown 00 - none 01 - 1 ma 02 - 2 ma 10 - 10 ma 99 - 99 ma	As reported to nearest milliampere
E. Milliampere-seconds per week	40-43	AAAA - not stated BBBB - unknown 0000 - none 0001 - 1 ma-sec/wk 0002 - 2 ma-sec/wk 1000 - 1000 ma-sec/wk 9999 - 9999 ma-sec/wk	As reported. Obtained by multiplying entries in cols. 29-31 by entries in Cols. 38-39 and multiplying that total with entry in cols. 35-37 (no. of films/wk x ma x av. exposure time)
F. Usual kilovoltage	44-45	AA - not stated BB - unknown 00 - none 01 - 1 kvp 02 - 2 kvp 45 - 45 kvp 99 - 99 kvp	As reported to nearest kilovolt

Item	Card Column	Code	Remarks
27. Film used			
A. Bitewing	46-47	See Attachment B	As reported - manufacturer and code
B. Periapical	48-49	See Attachment B	As reported - manufacturer and code
28. Darkroom procedures			
A. Developer used	50-51	See Attachment C	As reported - manufacturer
B. Development time	52-53	A.A - not stated 0.0 - none 0.5 - 1/2 minute 1.0 - 1 minute 1.5 - 1-1/2 minutes 9.5 - 9-1/2 minutes 9.9 - Sight	As reported to nearest 1/2 minute except for sight development
C. Temperature of developer	54-55	AA - not stated 00 - none 60 - 60 degrees 61 - 61 degrees 62 - 62 degrees 98 - 98 degrees 99 - thermometer not used	As reported - to nearest degree Fahrenheit except for thermometer not used
D. Thermometer Darkroom	56	A - not stated 0 - none 1 - yes 2 - thermostatic control 3 - no darkroom 4 - present but not in use	As reported
E. Usual change of developer	57-58	AA - not stated 00 - none 01 - every week 02 - every 2 weeks 03 - every 3 weeks 97 - every 97 weeks 98 - replenished only 99 - Sight	As reported to the nearest week for complete change
F. Is darkroom light tight	59	A - not stated B - unknown 0 - no 1 - yes	As reported - NOTE: if no darkroom in office, Code B

PHYSICAL RADIATION PROTECTION SURVEY REPORT OF DENTAL X-RAY EQUIPMENT INSTALLATIONS

CODING AND PUNCHING INSTRUCTIONS

Card #3

Item	Card Column	Code	Remarks	
Code				
State	1-2	01-51	From IBM Standard State Code	
County	3-5	001-999	From IBM Standard County Code	
City	6-8	001-999	From IBM Standard City Code	
Dentist identification	9-13	00001-99999	Dentist's identification number assigned in consecutive order within the State	
			Card Identification	
Card identification	14-15	11 first form	First page	Card #1
		12 second form	First page	Card #1
		22 second form	Second page	Card #2
		13 third form	First page	Card #1
		23 third form	Second page	Card #2
		33 third form	Third page	Card #3
		14 fourth form	First page	Card #1
		24 fourth form	Second page	Card #2
		34 fourth form	Third page	Card #3
		44 fourth form	Fourth page	Card #4
Total x-ray units at installation	16	A - not stated	As reported	
		0 - none		
		1 - 1 unit		
		2 - 2 units		
		3 - 3 units		
		9 - 9 units		
X-ray unit identification number	17	A - not stated	As reported - assigned by surveyor	
		0 - none		
		1 - first unit		
		2 - second unit		
		3 - third unit		
		9 - ninth unit		

Item	Card Column	Code	Remarks
29. Occupational Exposure Scatter Radiation TEST I: Left Bitewing Exposure			
A. Dentist			
Direction	18-19	01 - 1 o'clock 02 - 2 o'clock 03 - 3 o'clock etc.	As reported - using 12-hour clock around phantom patient
Distance	20	1 - 1 foot or less 2 - 2 feet 3 - 3 feet 9 - 9 feet or more	As reported to nearest foot within the circle
mr/hr	21-24	0001-9999	As recorded on survey instrument
New position mr/hr	25-27	001-999	As recorded on survey instrument
B. Assistant			
Direction	28-29	01 - 1 o'clock 02 - 2 o'clock 03 - 3 o'clock etc.	As reported - using 12-hour clock around phantom patient
Distance	30	1 - 1 foot or less 2 - 2 feet 8 - 8 feet 9 - 9 feet or more	As reported to nearest foot within the circle
mr/hr	31-34	0001-9999	As recorded on survey instrument
New position mr/hr	35-37	001-999	As recorded on survey instrument
TEST II: Anterior Upper Periapical Exposure			
C. Dentist			
Direction	38-39	01 - 1 o'clock 02 - 2 o'clock 03 - 3 o'clock etc.	As reported using 12-hour clock around phantom patient

Item	Card Column	Code	Remarks
Distance	40	1 - 1 foot or less 2 - 2 feet 8 - 8 feet 9 - 9 feet or more	As reported to nearest foot within the circle
mr/hr	41-44	0001-9999	As recorded on survey instrument
New position mr/hr	45-47	001-999	As recorded on survey instrument
D. Assistant			
Direction	48-49	01 - 1 o'clock 02 - 2 o'clock 03 - 3 o'clock etc.	As reported using 12-hour clock around phantom patient
Distance	50	1 - 1 foot or less 2 - 2 feet 8 - 8 feet 9 - 9 feet or more	As reported to nearest foot within the circle
mr/hr	51-54	0001-9999	As recorded on survey instrument
New position mr/hr	55-57	001-999	As recorded on survey instrument

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TEST III: Right Bitewing Exposure

E. Dentist			
Direction	58-59	01 - 1 o'clock 02 - 2 o'clock 03 - 3 o'clock etc.	As reported using 12-hour clock around phantom patient
Distance	60	1 - 1 foot or less 2 - 2 feet 8 - 8 feet 9 - 9 feet or more	As reported to nearest foot within the circle
mr/hr	61-64	0001-9999	As recorded on survey instrument
New position mr/hr	65-67	001-999	As recorded on survey instrument

Item	Card Column	Code	Remarks
F. Assistant			
Direction	68-69	01 - 1 o'clock 02 - 2 o'clock 03 - 3 o'clock etc.	As reported using 12-hour clock around phantom patient
Distance	70	1 - 1 foot or less 2 - 2 feet 8 - 8 feet 9 - 9 feet or more	As reported to nearest foot within the circle
mr/hr	71-74	0001-9999	As recorded on survey instrument
New position mr/hr	75-77	001-999	As recorded on survey instrument
30. Type of survey instrument used	78	A - not stated B - unknown 0 - none 1 - rate meter (Nucor) 2 - G.M. survey meter 3 - ionization chamber 9 - other	As reported

PHYSICAL RADIATION PROTECTION SURVEY REPORT OF DENTAL X-RAY EQUIPMENT INSTALLATIONS

CODING AND PUNCHING INSTRUCTIONS

Card #4

Item	Card Column	Code	Remarks
Code number			
State	1-2	01-51	From IBM Standard State Code
County	3-5	001-999	From IBM Standard County Code
City	6-8	001-999	From IBM Standard City Code
Dentist identification	9-13	00001-99999	Dentist's identification number assigned in consecutive order within the State
Card identification	14-15	11 first form 12 second form 22 second form 13 third form 23 third form 33 third form 14 fourth form 24 fourth form 34 fourth form 44 fourth form	Card Identification First page Card #1 First page Card #1 Second page Card #2 First page Card #1 Second page Card #2 Third page Card #3 First page Card #1 Second page Card #2 Third page Card #3 Fourth page Card #4
Total x-ray units at installation	16	A - not stated 0 - none 1 - 1 unit 3 - 3 units 6 - 6 units 9 - 9 units	As reported
X-ray unit identification number	17	A - not stated 0 - none 1 - first unit 2 - second unit 3 - third unit 9 - ninth unit	As reported - assigned by surveyor

Item	Card Column	Code	Remarks
31. Beam Quality determination (Cap ON/Cap OFF method)			
A. KVP for this exposure	18-19	AA - not stated BB - unknown 00 - none 01 - 1 kvp 02 - 2 kvp 60 - 60 kvp 99 - 99 kvp	As recorded by x-ray units instrument in kilovolts
B. Ma for this exposure	20-21	AA - not stated BB - unknown 00 - none 01 - 1 ma 02 - 2 ma 15 - 15 ma 99 - 99 ma	As recorded by x-ray units instrument in milliamperes
C. Chamber A Cap OFF	22-24	A.AA - not stated B.BB - unknown 0.01 - 1/100 r/sec 0.05 - 1/20 r/sec 0.97 - 97/100 r/sec 1.50 - 1-1/2 r/sec 9.99 - 9-99/100 r/sec	As calculated from seconds and number of roentgens as read from integrated meter in 100ths of roentgens per seconds
D. Chamber B Cap OFF	25-27	A.AA - not stated B.BB - unknown 0.01 - 1/100 r/sec 0.05 - 1/20 r/sec 0.97 - 97/100 r/sec 1.50 - 1-1/2 r/sec 9.99 - 9-99/100 r/sec	As calculated from seconds and number of roentgens as read from integrated meter in 100ths of roentgens per second
E. Chamber A Cap ON	28-30	A.AA - not stated B.BB - unknown 0.01 - 1/100 r/sec 0.05 - 1/20 r/sec 0.97 - 97/100 r/sec 1.50 - 1-1/2 r/sec 9.99 - 9-99/100 r/sec	As calculated from seconds and number of roentgens as read from integrated meter in 100ths of roentgens per second
F. Chamber B Cap ON	31-33	A.AA - not stated B.BB - unknown 0.01 - 1/100 r/sec 0.05 - 1/20 r/sec 0.97 - 97/100 r/sec 1.50 - 1-1/2 r/sec 9.99 - 9-99/100 r/sec	As calculated from seconds and number of roentgens as read from integrated meter in 100ths of roentgens per second

Item	Card Column	Code	Remarks
G. Ratio Cap ON/Cap OFF Chamber A	34-36	.AAA - not stated .BBB - unknown .001 - .001 .050 - .050 .100 - .100 .500 - .500 .999 - .999	As calculated by dividing roentgens per second for Chamber A (Cap ON) by roentgens per second for Chamber A (Cap OFF) in 1000ths
H. Half Value Layer Calculated	37-39	A.AA - not stated B.BB - unknown 0.01 - 0.01 mm 0.50 - 0.50 mm 1.00 - 1.00 mm 2.50 - 2.50 mm 9.99 - 9.99 mm	As determined by reading value from graph for established ratio - in millimeters of aluminum equivalent
I. Total Aluminum Equivalent Filtration	40-42	A.AA - not stated B.BB - unknown 0.01 - 0.01 mm 0.50 - 0.50 mm 1.00 - 1.00 mm 2.50 - 2.50 mm 9.99 - 9.99 mm	As determined by reading value from graph for established half value layer - in milliamperes of aluminum equivalent

Attachment A

X-Ray Unit - Manufacturer and Model

AA - not stated

BB - unknown

00 - none

Code	Manufacturer	Model
01	Ritter	A
02	Ritter	B
03	Ritter	Dual-X
04	Ritter	E (Century)
05	Ritter	F
06	Ritter	Model not stated or other
07	Ritter	G
08	Ritter	H (Mark 75)
15	General Electric	Victor (old style)
16	General Electric	CDX-E
17	General Electric	70 and 73
18	General Electric	90
19	General Electric	Model not stated or other
20	General Electric	100
30	Weber	5
31	Weber	6
32	Weber	6A
33	Weber	6B
34	Weber	6R
35	Weber	7
36	Weber	7A
37	Weber	9
38	Weber	9A
39	Weber	11
40	Weber	11R
41	Weber	Raydex (70)
42	Weber	Raydex 12R (90)
43	Weber	Model not stated or other

Code	Manufacturer	Model
60	X.R.M.	2A
61	X.R.M.	3A
62	X.R.M.	90
63	X.R.M.	70W
64	X.R.M.	Panoramic
65	X.R.M.	Model not stated or other
70	Philips Oralix	45
71	Philips Oralix	50
72	Philips	All models
75	Universal	All models
77	Westinghouse	All models
79	Fischer	All models
80	Liebel Flarsheim	All models
82	Meyer	All models
84	Wappler	All models
85	Grenz-Ray	All models
86	Norelco	All models
87	Warte and Bartlett	All models
88	G.M. McFedrier	All models
89	Mattern	All models
90	Picker	All models
91	Profexray	All models
92	Professional Equipment Corp.	All models
93	Pony	All models
94	Adams	All models
95	Pengelly	All models
96	X-Cell-Ray	All models
97	Siemens	All models
99	Other	All models

Attachment B

MANUFACTURER AND CODE BY SPEED OF FILM
(Item 27, Film Used)*

	Speed Group Reciprocal r. 1.5 - 3.0 A		Speed Group Reciprocal r. 3.0 - 6.0 B		Speed Group Reciprocal r. 6.0 - 12.0 C		Speed Group Reciprocal r. 12.0 - 24.0 D	
Kodak	~~01~~	~~DF-13~~	20	DF-1	~~50~~	~~DF-45~~	70	DF-38
	~~02~~	~~DF-18~~	21	DF-7	~~51~~	~~DF-[illegible]~~	71	DF-40
	~~03~~	~~DF-19~~	22	DF-37			72	DF-42
			23	DF-39		DISCONTINUED	73	DF-48
		DISCONTINUED	24	DF-41			74	DF-51
			25	DF-43			75	DF-55
			26	DF-49			76	DF-57
							77	DF-58
DuPont	~~04~~	~~25S-1~~	27	25D-1			78	25LF-1
	~~05~~	~~25S-2~~	28	25D-2			79	25LF-2
	~~06~~	~~150S-1~~	29	150D-1			80	150LF-1
	~~07~~	~~150S-2~~	30	150D-2			81	150LF-2
			31	25BW				
Rinn	~~08~~	~~DC-1~~	32	MF-1	52	EF-1	82	SF-1,S-1
	~~09~~	~~DC-2~~	33	MF-N-1	53	EF-N-1	83	SF-N-1,S-N-1
	~~10~~	~~DC-N-1~~	34	MF-O-1	54	EF-O-1	84	SF-O-1,S-O-1
	~~11~~	~~DC-O-1~~	35	MF-2	55	EF-2	85	SF-2,S-2
	~~12~~	~~DC-N-2~~	36	MF-N-2	56	EF-N-2	86	SF-N-2,S-N-2
	~~13~~	~~DC-O-2~~	37	MF-O-2	57	EF-O-2	87	SF-O-2,S-O-2
	~~14~~	~~3-DC~~	38	3-MF	58	3-EF	88	3-SF,3-S
	~~15~~	~~2-DC~~	39	2-MF	59	2-EF	89	2-SF,2-S
Minimax	~~16~~	~~RB~~	40	BS	60	EFS		
	~~17~~	~~RD~~	41	BD	61	EFD		
	~~18~~	~~RT~~	42	BT	62	EFT		
			43	3-B	63	3-EF		
			44	3B x 6	64	3-EF x 6		
			45	OB	65	O-EF		
			46	OB x 3	66	O-EF x 3		
IFI			47	BH	67	SBH	68	UBH
Other	99							

*** Underlined figures are codes to be used on machine tabulating cards to identify the specific film by manufacturer and film code.**

Attachment C

DEVELOPER BY MANUFACTURER

(Item 28, Darkroom Procedures - Developer Used)

AA - Not stated
00 - None
01 - Ace X-ray service
02 - Ansco liquid
03 - DuPont
04 - G.E.
05 - G.E. supermix
06 - Kerr FR
07 - Kodak
08 - Minimax
09 - Oneida
10 - Rinn
11 - X.R.M.
99 - Other

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